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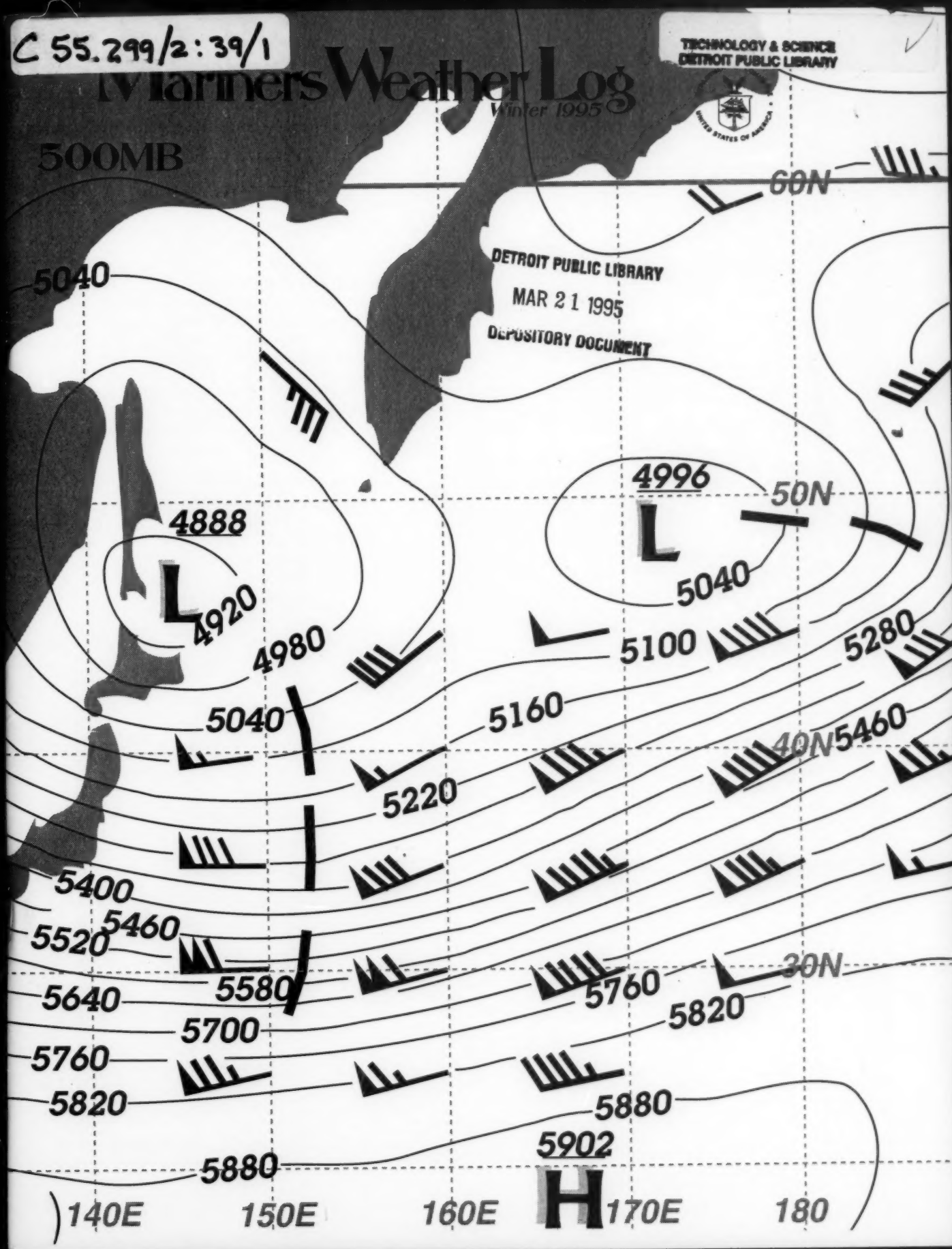
Mariners Weather Log

Winter 1995



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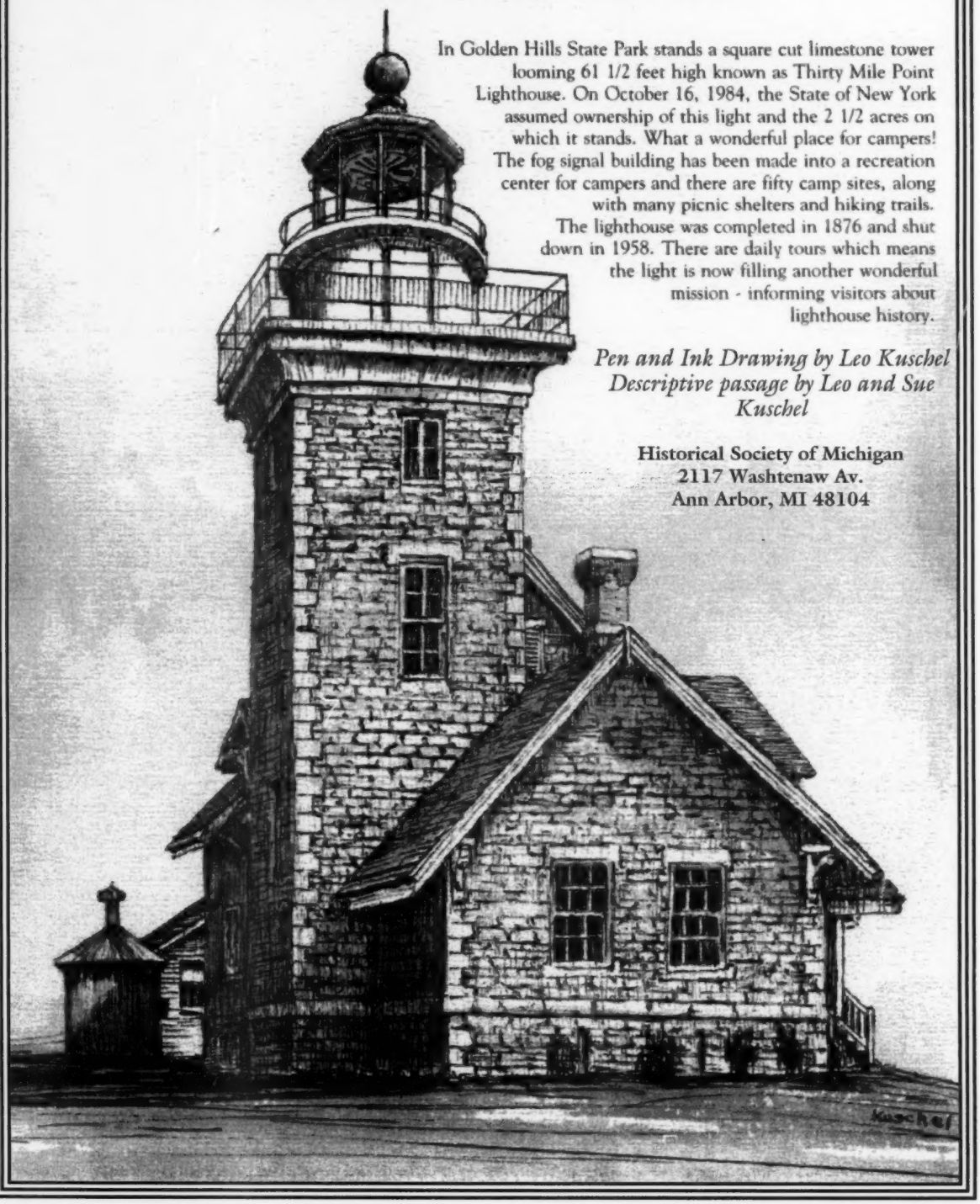
Thirty Mile Point Light

Lake Ontario, Olcott, New York



In Golden Hills State Park stands a square cut limestone tower looming 61 1/2 feet high known as Thirty Mile Point Lighthouse. On October 16, 1984, the State of New York assumed ownership of this light and the 2 1/2 acres on which it stands. What a wonderful place for campers! The fog signal building has been made into a recreation center for campers and there are fifty camp sites, along with many picnic shelters and hiking trails. The lighthouse was completed in 1876 and shut down in 1958. There are daily tours which means the light is now filling another wonderful mission - informing visitors about lighthouse history.

Pen and Ink Drawing by Leo Kuschel
Descriptive passage by Leo and Sue Kuschel

Historical Society of Michigan
2117 Washtenaw Av.
Ann Arbor, MI 48104

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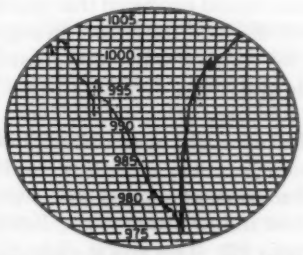

Barograph trace from the ***President Washington.*** *Story on page 4.*

Cover: The 48–hour 500–millibar forecast chart from the NWS Marine Forecast Branch is available by radio facsimile to mariners.

Centerfold: The ***Aquitania*** by Antonio Jacobsen. This lovely and very rare snow scene is from the Collection of Stephen L. Gaillard and was painted in 1914. The Mariners Museum provided the photograph and is taking its Antonio Jacobsen's *Painted Ships on Painted Oceans* exhibition on the road.

Back Cover: NODC Oceanographer Sheri Phillips was taking part in a research project aboard the NOAA ship ***Oregon II*** when she photographed these short nosed dolphins in the Gulf of Mexico.

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Mariners Weather Log

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The Secretary of Commerce has determined that the publication of this periodical is necessary in the transaction of the public business required by law of this Department. Use of funds for printing this periodical has been approved by the Director of the Office of Management and Budget through July 1, 1995.

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Washington DC 20235.

Hangin 'em up

When is it time to hang 'em up as the old baseball cliche goes? Do you wait until they drag you off kicking and screaming or do you get out while you still have a semblance of sanity. Well, the jury is still out on me, but I'm not kicking. Instead of a premature obituary or thanking all the little people, I thought I'd leave some advice to the next editor.

Make the *Mariners Weather Log* a labor of love or it will kill you. Depend foremost on your associate editor for she is wonderfully supportive and brilliant as well. Rely on your columnists and other specialists as they will save you time and effort and will greatly improve the quality of the Log, making you look like a genius. Seek help from the marine community– the Coast Guard, maritime academies, museums and meteorological offices. They are a generous and understanding lot. Enlist the aid of mariners themselves. There is no way to duplicate the experience and insight they can offer. Most of all rely on the Port Meteorological Officers of the world. A harder working, more dedicated and lower paid group of wonderful people you won't find anywhere. They are your eyes and ears to the marine community. Consider their needs, take their advice and keep them happy, and you will be a success.

Retirement for me will consist of photography, writing, antiquing, crabbing, fishing and travelling. My wife, Kirsten, and I will remain in the Washington area for a couple of years. One of our major excursions will be a trip through the fjords of Norway and around the North Cape (maybe I can send back a few observations). I hope to keep in touch with the many friends in the maritime community. My address is 315 West St., Vienna, VA 22180. Now, on to more important things like the issue at hand.

This issue is one that we are particularly proud of thanks to the efforts of Joe Sienkiewicz and Lee Chesneau. Former editor Earl Wilson brought the concept of upper air analyses to the *Log*, but until now I have not done much to promote it. One problem was lack of time and the other was a belief that mariners would not be all that quick to use it. However, you can teach an old dog new tricks and through my visits to the maritime academies and my contacts with ship's masters, this old dog realized that mariners will use everything they can to get a jump on the weather. Still, until Lee and Joe came along, I wasn't sure that the 500–millibar concept could be presented in an understandable way to people (including me) who were less than specialists. Well, take a look at their article, it is a beauty. One concept in good article writing, is for an article to grab you by the throat and say listen to me, I may save you money or time or even save your life. This article embodies that concept for the weatherwise mariner or sailor. We are proud to run it in the *Log* and are planning on reprinting it for general distribution. We have not had article reprints for a decade, but this article warrants it. If you have a use for copies, let us know and we will try to get some to you.

Dick DeAngelis

U.S. Department of Transportation

United States Coast Guard

Commander
International Ice Patrol

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Groton, CT 06340-6095
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16170
14 January 1995

Dear High Seas Marine Safety Information Users;

I am pleased to announce that the 1995 International Ice Patrol Announcement of Services is now available. As in previous years, the Announcement of Services lists broadcast stations, frequencies, and times for Ice Patrol's products.

Summarized below are significant changes from recent year's Announcement of Services:

♦ INMARSAT-equipped vessels can make iceberg reports to Ice Patrol at no charge using INMARSAT service code 42.

♦ Ice Patrol has added a second Radio-Facsimile broadcast at 1810 UTC in addition to the 1600 UTC broadcast. The frequencies for both broadcasts are 6340.5 kHz and 12750 kHz.

♦ Ice Patrol's Radio-Facsimile chart is available to at-sea users free of charge on COMSAT's INMARSAT-A FAXMAIL server. There is a charge for the telephone call. Shore-side users can poll the Radio-Facsimile chart from Ice Patrol's telephone facsimile by calling (203) 441-2773. We suggest you refer to your specific telephone facsimile manufacturer's polling/manual-receive instructions.

The entire Announcement of Services is available and can be obtained via computer on the Coast Guard Navigation Center's computer bulletin board (703) 313-5910. The Announcement can also be obtained by writing or calling International Ice Patrol at the address or phone number listed above.

If you have ideas or suggestions for ways that International Ice Patrol can better serve your needs, we would like to hear from you. I express my appreciation to all the mariners who have provided iceberg sighting reports and supported our efforts to provide maritime safety in the North Atlantic.

R. TUXHORN
Commander, U. S. Coast Guard
Commander, International Ice Patrol

"Big whirls have little whirls which feed on their velocity. Little whirls have lesser whirls. And so on to viscosity." –*L.F. Richardson*

Mariner's Guide to the 500–Millibar Chart

Joe Sienkiewicz and Lee Chesneau
National Weather Service

Detailed stock and bond information is available daily. For those willing to expend the time and effort to analyze these data the rewards can be gratifying. The same can be said in maritime circles of the surface and 500–millibar charts, provided on marine radiofacsimile by the U.S. Coast Guard from NMF (Marshfield, MA) and NMC (Pt. Reyes, CA). Both transmit five 500–millibar (mb) charts each day (two analyses, two 48–hour forecasts and one 96–hour forecast).

For your investment decisions you can depend on your broker, just as you can turn to your weather forecaster for route decisions. In both cases it is the prudent individual who uses all available resources and makes his own final decision.

The professional mariner and ocean sailor can use the 500–mb analyses and forecasts in combination with surface pressure charts to better understand and anticipate the workings of the atmosphere. With a little bit of knowledge and pattern recognition experience, you will be able to make more educated decisions concerning upcoming weather and the movement of low pressure systems.

Surface Weather Chart Basics

Surface weather charts that depict isobars, high and low centers and a variety of weather fronts are familiar to mariners. The general perception is that lows are associated with bad weather and highs mean light winds near the center with generally fair weather, but there is more to it than that. Isobars are lines of equal pressure on the surface of the earth– at the bottom of the atmosphere. Therefore, this surface pressure is a direct measure of all of the processes that are happening from upper and mid-levels in the atmosphere down to the surface! These processes include cold air sinking, warm, moist air rising, precipitation, and air streams or jet streams coming together (converging) or spreading apart (diverging). The surface pressure pattern is actually a two dimensional representation of the three dimensional atmosphere!

If you look at a surface map and think that the low over Chicago today will be over New England tomorrow and affecting my vessel the day after, you are forecasting by continuity. This is moving the existing state of the atmosphere (lows, highs and fronts) around the earth without taking account of all the processes involved. In the early part of this century that is the way meteorologists first forecast storm systems.

If you learn anything from this article remember that the atmosphere is dynamic! The surface pressure field responds to changes in the atmosphere aloft and vice versa. Storms have life cycles; they are born, some grow and strengthen, and eventually they spin down and die. The intensity and length of life of a low is a direct result of interaction between the lowest level in the atmosphere and mid and upper levels. An excellent measure of this interaction is the 500–mb height field. (Note: Z time is the same as UTC.)

Joe Sienkiewicz and Lee Chesneau are High Seas Forecasters in the Marine Forecast Branch of the National Meteorological Center located in Washington, D.C. Both have written excellent articles for the Mariners Weather Log *in the past, in addition to their strenuous marine forecast duties.*

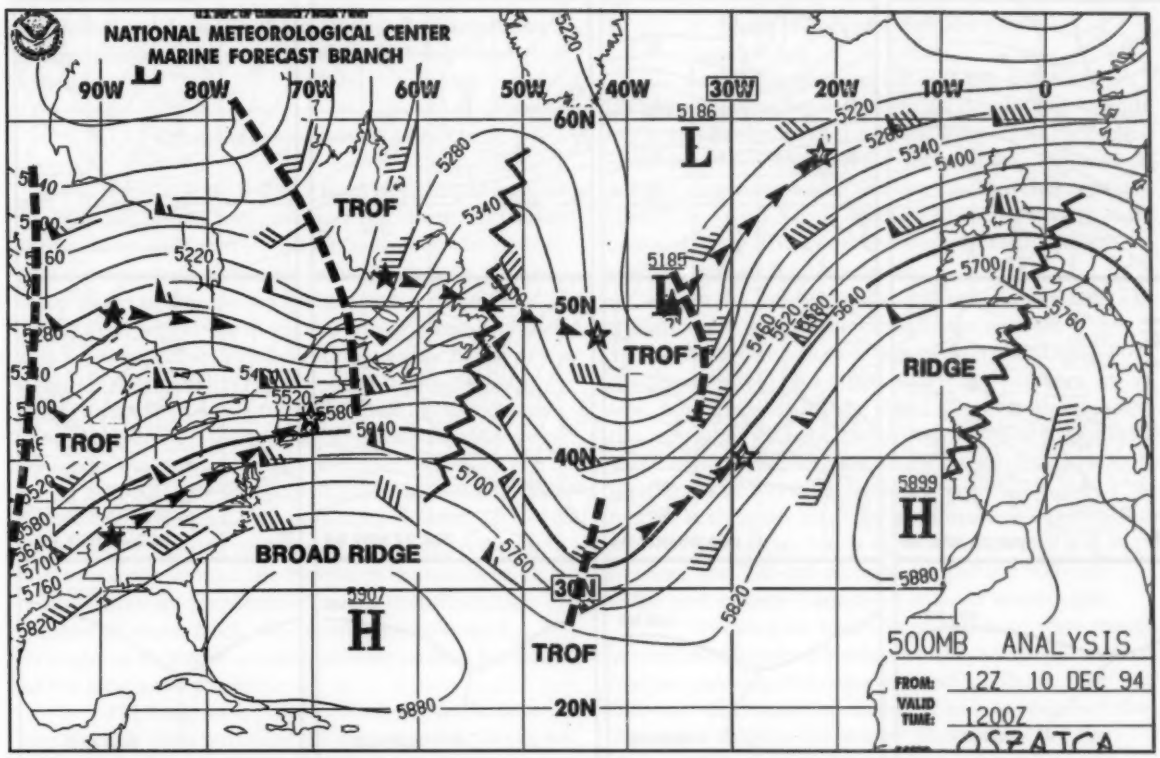


Figure 1. The 500-millibar analysis for 12Z December 10, 1994. Short wave troughs are shown by a dashed line. Zigzag lines indicate ridge axes. The location of surface low pressure centers at 12Z December 10 are indicated by a star. Observed 24 hour tracks of lows are shown by arrow heads, and the observed position of low centers at 12Z December 11 are shown with an open-faced star.

The 500-millibar Basics

The 500-mb surface is a constant pressure surface approximately midway up in the troposphere (the lowest layer of the earth's atmosphere). The pressure exerted by the air column above this level is exactly 500 mb, but the height of this surface varies. The 500-mb constant pressure surface generally averages approximately 5600 meters (18,000 feet) in height but can vary from roughly 4700 meters in an extremely cold (more dense) atmosphere to nearly 6000 meters in a very warm (less dense) atmosphere.

The solid contours shown on the 500-mb chart (Figure 1) represent geopotential height (basically, height in whole meters with a slight difference). The number 5640 means 5640 meters. In a sense you are looking at a topographic map of the 500-mb pressure surface. **The 500-mb heights are higher in warmer air masses (less dense) and lower in colder air masses (more dense).** Therefore, the heights generally are lower to the north and higher to the south. In Figure 1, look at the height differences from the contour at 30°N, 30°W (5820) and south of Iceland near 60°N, 20°W (5220) meters (approximately 600 meters difference).

The closer the 500-mb height contours are together, the stronger the horizontal and vertical temperature contrasts and the faster the wind speed at 500 mb (the wind at this level is for the most part parallel to the height contours). A simple rule of thumb– **the tighter the height contours, the higher the wind speed, the stronger the temperature difference below 500 mb.** In Figure 1, a strong band of southwesterly winds extends from near 30°N, 40°W to northern Scotland– good indication that a moderate to strong surface front exists in this area.

Winds at 500 mb are generally not the actual jet stream, which is usually between 200 and 300 mb. Jet streams exist due to horizontal temperature contrasts. In an extremely cold atmosphere, the arctic jet stream can extend down to 500 mb. However, meteorologists do call wind speed maxima at 500 mb jets or jet streaks. On the 500-mb charts distributed over radiofacsimile, only 500-mb heights and winds are depicted. The distribution of height contours and therefore the strength of 500-mb winds implies the

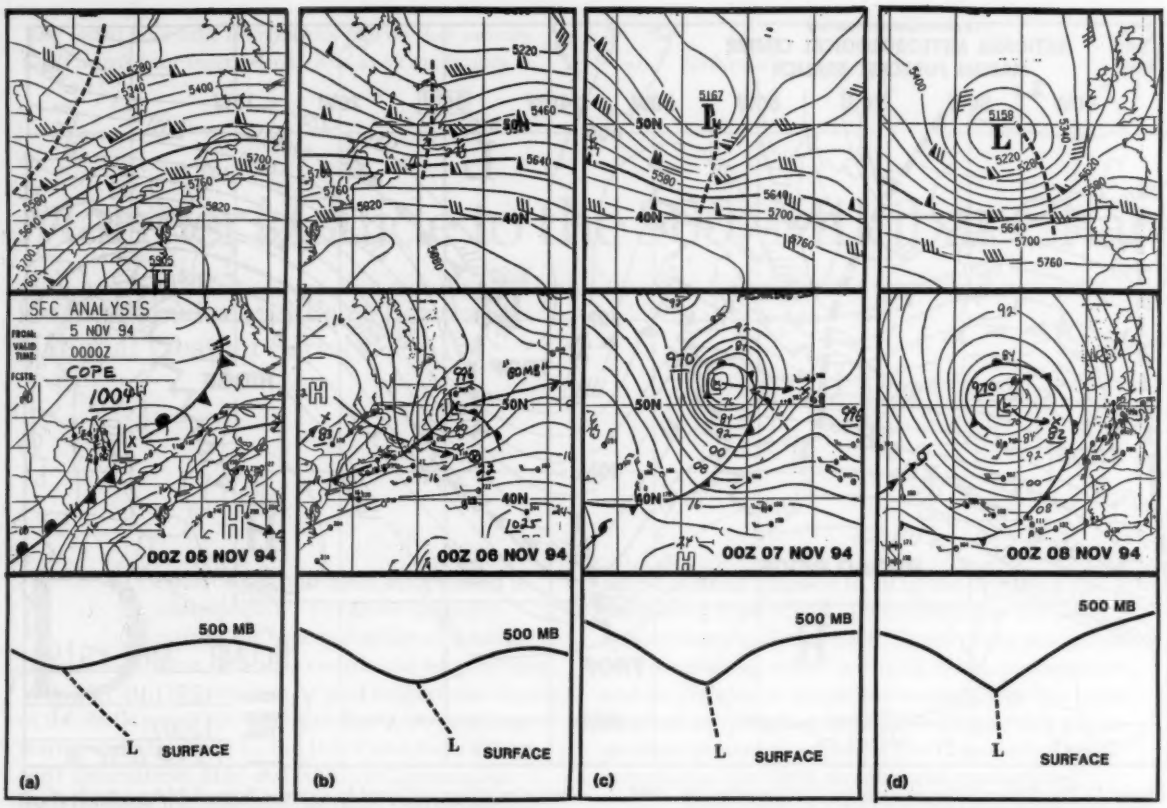


Figure 2. The four panel diagram shows the 500-mb analyses and short wave trough axes (dashed line), surface pressure analyses, and vertical cross-sections of 500-mb pressure surface, surface low position and vertical trough axis (dashed line) for (a) 0000Z November 5, (b) 0000Z November 6, (c) 0000Z November 7, and (d) 0000Z November 8, 1994.

strength of horizontal temperature contrasts.

L's and H's represent areas of relatively higher and lower heights. An L or H with a closed contour around it implies that the high or low has a closed circulation with the wind circulating around it. In Figure 1, a 5899 closed high can be seen just west of the Straits of Gibraltar. An open 5185 low can be seen at 50°N, 37°W (there is no closed height contour and no closed circulation).

Troughs are areas of relatively lower heights and are U or V-shaped in the contours. Several troughs axes are indicated in the chart by dashed lines. For example, a trough extends from just east of Hudson Bay to the Canadian Maritimes. A more complex area of troughing can be seen in the mid-Atlantic with one trough along 35°W and a second between 40° and 50°W south of 40°N.

Ridges are areas of higher heights and are shaped like an upside down U or V and are indicated by a zigzag line. A strong ridge extends north northeastward from off the African Coast to the British Isles. A broader, flatter ridge can be seen off the southeast U.S. coast extending to between 50°W and 60°W.

On the charts distributed over radiofacsimile by NMC and NMF, the **5640**-meter height contour is enhanced in bold. Some basic rules of thumb used by marine meteorologists concerning the **5640** contour and 500 mb wind maxima are as follows:

– In wintertime the 5640 contour is an excellent indication of the southern extent of surface winds of force 7 westerlies or greater. In summer the 5640 height contour is more representative of force 6 surface westerlies.

– The surface storm track is usually 300 to 600 nautical miles north and parallel to the 5640 height contour.

– Fronts (cold fronts, in particular) and surface storm centers move at approximately ⅓ to ½ the 500-mb wind speed.

– The surface wind speed, especially in the west to

southwest quadrant (in the cold air) of a surface low is approximately 50 percent of the 500-mb wind speed.

Long Waves—Short Waves

If you could look at a time lapse movie loop of the 500-mb height contours over the Northern Hemisphere for a year, you would see a westerly circulation undulating northward and southward as what appear to be waves of troughs and ridges pass around the globe. The bigger waves appear to stand still or move slowly for a period of time and then either break down or move westward. When a larger wave moves westward, it is said to retrograde. The smaller waves move quite rapidly from west to east and tend to enhance or flatten as they pass through the larger waves.

The bigger waves are called long waves or long wave troughs and have a wavelength between 50 to 120 degrees of longitude and number from approximately three to seven around the Northern Hemisphere. These waves are responsible for the overall weather pattern or storm track. For example, prolonged drought or excessive storminess over an area is a result of the long wave pattern.

The long wave pattern tends not to fluctuate significantly for a period of 10 days or more. It can be difficult to pick out the long waves on the mercator projection charts distributed on radiofacsimile over NMF and NMC. This is due in part to the type of projection and extent of the area covered by these charts. A hemispheric chart projection of the mean 500-mb pattern for a period of several days is more useful for this purpose.

The smaller wave troughs that travel rapidly in the westerly flow are called short wave troughs or simply short waves. Short waves are associated directly with specific low pressure systems. They tend to have a life cycle of less than a week and rotate through the longer wave troughs. Their size tends to be on the order of 1000 to 2500 kilometers in scale.

The long waves and short waves interact like wind waves and swell. When in phase, a wind wave tends to enhance the swell making a significantly higher amplitude wave. When out of phase, the wind wave will tend to dampen or flatten the swell. Similar interactions occur in the atmosphere. When in phase, short waves help to enhance the longer wave pattern and are themselves enhanced or gain amplitude (this results in stronger surface lows). When out of phase, the short waves can dampen the long wave pattern and in turn their amplitude can be reduced (flattened).

Short Waves and Surface Lows

Let's take a look at the 500-mb and surface pressure patterns associated with a developing Atlantic low pressure system in the fall of 1994. The four panels 24 hours apart (Figure 2) show the development of a short wave trough (dashed line) and surface cyclone as they move off North America in strong west to east or zonal flow. The low then strengthens to a storm over the central North Atlantic.

In the first frame the 500-mb short wave trough is still west of the Great Lakes with the 1004-mb surface low over southeastern Ontario. For the development of a mid-latitude low pressure system, it is necessary for the short wave trough axis in the vertical to tilt back toward cold air (lower heights) with height. A typical distance is a quarter wavelength separation between the surface low and 500-mb trough at the early stages of development. You can see that the surface low is approximately half way between the 500-mb trough axis and the 500-mb ridge over eastern Canada– a quarter wavelength.

Twenty-four hours later, the short wave trough is over the Canadian Maritimes with a 996-mb surface low just crossing the coast of Newfoundland. The 500-mb short wave has flattened as it crosses over the top of the ridge to the south. The surface low has deepened 8 mb over the past 24 hours and the distance between the 500-mb trough axis and surface low has closed by about half the original distance. To indicate that this low is expected to deepen explosively over the next 24 hours, the forecaster has written the word "bomb" along the expected track of the low. In the future the Marine Forecast Branch will refer to lows deepening 24 mb in 24 hours as "rapidly intensifying" as opposed to "bombs."

In the third panel explosive deepening has indeed taken place. The surface low has deepened 26 mb over the past 24 hours. The 500-mb short wave trough has amplified (become more U or V shaped or extended north to south). We no longer have just a 500-mb trough but now have a 5167-meter low center just to the west of the surface low. The upper-level low is beginning to "close off" meaning height contours are beginning to encircle the low at 500 mb. The closing off of the 500-mb low indicates the closed circulation has grown with height from the surface to 500 mb. Closing off is a good indication that the surface low is beginning to slow. There is still some tilt of the trough to the west suggesting that the surface low will still deepen a little more.

In the last frame the surface low and 500-mb low are vertically stacked with little or no tilt of the upper-level trough. This indicates that the atmospheric column has become more homogeneous in tempera-

ture and moisture content. The surface low has matured (968 mb at 1200Z) and is beginning to fill or weaken. A well defined closed circulation now extends to greater than 500 mb.

In this sequence we have seen three stages in the life cycle of a short wave trough. First is the developing phase where the 500-mb short wave trough lags behind the surface low and amplifies with time. The tilt of the trough axis in the vertical decreases with time and the surface low deepens. The second or closing off phase is shown in panel C as height contours begin to encircle the newly formed 500-mb low and close off the vortex. The circulation has become closed from the surface to 500 mb and the surface low slows its forward motion. In the mature phase, the 500-mb low is vertically stacked above the surface low. There is no more deepening and the cyclone begins to fill.

To summarize, this low pressure system in 72 hours moved from the Great Lakes to 20°W and deepened 36 mb. The rapid speed of motion was a direct result of the 500-mb flow being west to east or zonal.

Behavior of Short Wave Troughs

Let's follow the 500-mb wind maxima through the life of two short wave troughs as they interact. The 500-mb and surface analyses for every 12 hours from 1200Z October 12 to 0000Z October 15, 1994 are shown for this mid Pacific development in Figure 3.

At 12Z October 12, a benign looking 1010-mb low can be seen at 33°N, 176°E with a weak short wave 500-mb trough at approximately 172°E (there is some tilt with height, so further deepening is expected). Upstream, south of Kamchatka, is a moderate northwest flow to 65 knots and a fairly flat short wave trough (second dashed line) along 163°E. However, energy at 500 mb is poised to dig southeastward from the second short wave toward the 1010-mb low. Without the 500-mb chart one would not expect much in the way of deepening of this surface low.

By 00Z October 13, the two short waves have begun to phase as indicated by the two dashed lines beginning to line up and have amplified over past 12 hours (become more V or U shaped). There is also some short wave ridging (upside down U curvature of the height contours) to the east as indicated by the zigzag line. The surface low has deepened 10 mb— nearly 1 mb per hour during the past 12 hours.

Twelve hours later the surface low has deepened another 15 mb to 985 mb and the pressure gradient has dramatically tightened in the northwest quadrant of the low. Storm force winds should be expected in this region. At 500 mb the wind maxima has now spread to the east of the trough. An 80-knot maxima exists in the northwest flow along 40°N. The trough axes are lined up as the two short waves are now phased.

At 00Z October 14, the open trough at 500 mb has closed off a 5436-meter low— a circulation now extends up to 500 mb. The 500-mb wind maxima continues to grow to the east of the storm as the low moves slowly northeastward. The low is now vertically stacked and has nearly completed its deepening. One ship observed a 50-knot northeast wind north of the storm system.

By 12Z October 14, although the 500-mb low is at 5416 meters, the closed contours have opened up. The 500-mb low is lifting northeastward while the surface low is elongated toward the northeast as indicated by a second low shown near the intersection of the warm and cold fronts. The wind maxima at 500 mb is evenly distributed east and west of the 500-mb trough but is growing on the east side, so the 500-mb low is beginning to open up and lift out. Twelve hours later the 500-mb low has opened up and dissipated. The 500-mb wind maxima to the west of the system is gone and the bulk of the wind energy is now east of the northeastward-pointing short wave trough axis. The surface low is elongating northeastward— the direction the toward which the strongest 500-mb winds are blowing.

In review, the greatest deepening in the surface low took place during the first three time periods as the two 500-mb short wave troughs phase, and the strong wind maxima begins to extend around the base of the 500-mb short wave trough. The cyclone is vertically stacked at 00Z October 14 with the closed 500-mb low right over the surface low and wind maxima continuing to strengthen east of the 500-mb trough axis. Little or no deepening should be expected after this point. In the final two frames, we see the wind maxima weaken west of the system and strengthen to the east of the 500-mb trough axis, the closed 500-mb low opens up to a trough and the surface low begins to weaken and elongate northeastward. This sequence is fairly typical for the formation of a low and evolution of the 500-mb trough and associated wind maxima.

500 Millibar Patterns

Now that we have gone over the behavior of 500-mb short wave troughs and surface cyclones, let's take a look at some typical 500-mb flow patterns.

Zonal Pattern

Rapid west to east flow where the 500-mb

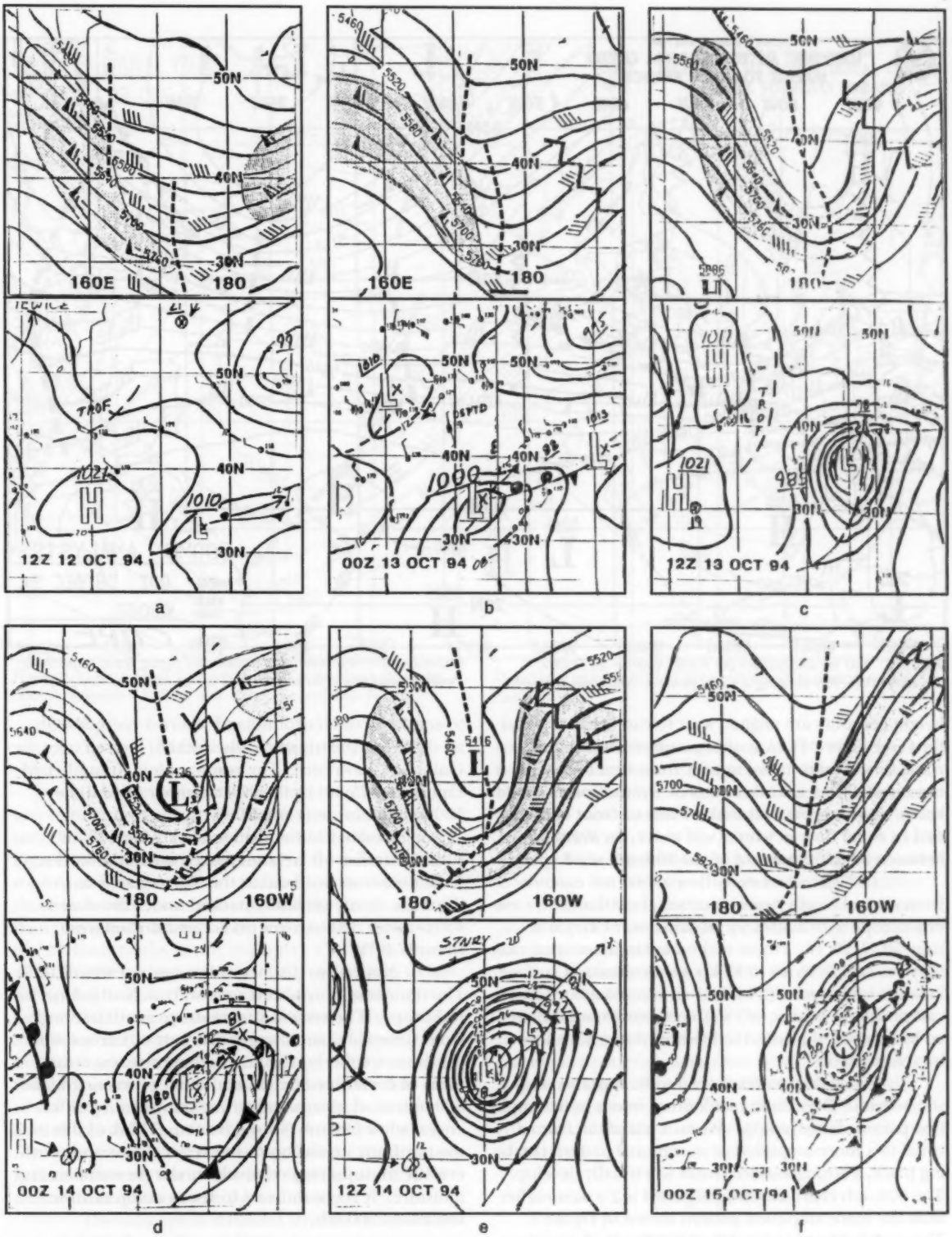


Figure 3. Six panel diagram showing 500–mb and surface pressure analyses for: (a) 1200Z October 12, (b) 0000Z October 13, (c) 1200Z October 13, (d) 0000Z October 14, (e) 1200Z October 14, and (f) 0000Z October 15, 1994.

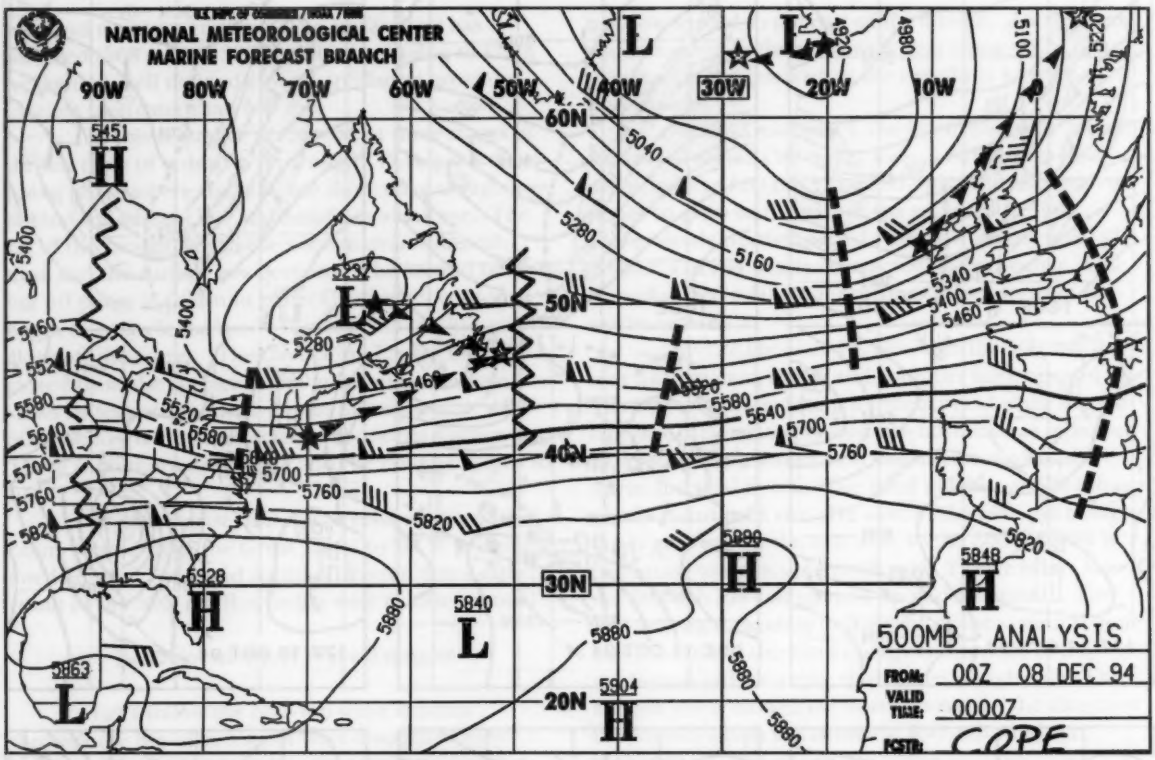


Figure 4. 500 mb analysis for the North Atlantic for 0000Z December 08, 1994 showing a zonal pattern. Short wave troughs and ridges are indicated with dashed and zigzag lines, respectively. Positions and tracks for surface lows are as indicated in figure. 1.

height contours are aligned west to east is called zonal flow (see Figure 4). Any short waves embedded in zonal flow tend to move rapidly from west to east. It is not unusual to see surface lows or fronts move 35 to 50 knots. A good rule of thumb: **a low or front embedded in zonal flow in winter will move, on average, between 30 to 50 percent of the 500-mb wind speed.**

In Figure 4 westerly flow at 500 mb extends from central North America across the Atlantic to western Europe with a 90-knot maxima over Ohio and near 50°N, 20°W. Fronts embedded in these areas may move as rapidly as 40 to 45 knots. Positions of surface lows are indicated with a filled-in star; 24-hour forecast positions valid at 0000Z December 09 are indicated by an open star with the 24-hour low track shown by arrowheads.

Zonal flow patterns tend to be unstable and short-lived. They often break down into a more amplified pattern fairly rapidly. When a transition from a zonal to a more amplified or meridional pattern is taking place, a strong surface storm will usually develop. The 500-mb chart shown in Figure 4 is 2½ days earlier than the more amplified pattern shown in Figure 1. The surface low center off the New England coast in Figure 4 moved east northeastward at nearly 30 knots to southeast of Newfoundland where it merged with an older low (nearly vertically stacked) located over the Gulf of St. Lawrence. The resultant low strengthened rapidly to 975 mb by 0000Z December 09 and the 500-mb pattern was amplified.

Another low embedded in strong 500-mb southwesterlies off Ireland, moved northeastward at 35 knots across Scotland to the Norwegian Sea. A third low nearly vertically stacked under the closed 4891-meter 500-mb low off Iceland drifted west towards 30°W.

Notice two distinct ribbons or streams of flow. The dominant flow is west to east from North America to Europe. The second stream drops southeastward from Greenland and merges just west of Europe with the more southerly stream. Merging streams create areas of constricted height contours, generating higher 500-mb wind speeds and strong temperature differences below 500 mb (strong fronts). Think of this as the northern stream supplying very cold air and southern stream supplying relatively moderate warm air and moisture. It is not unusual to see as many as three streams at 500 mb.

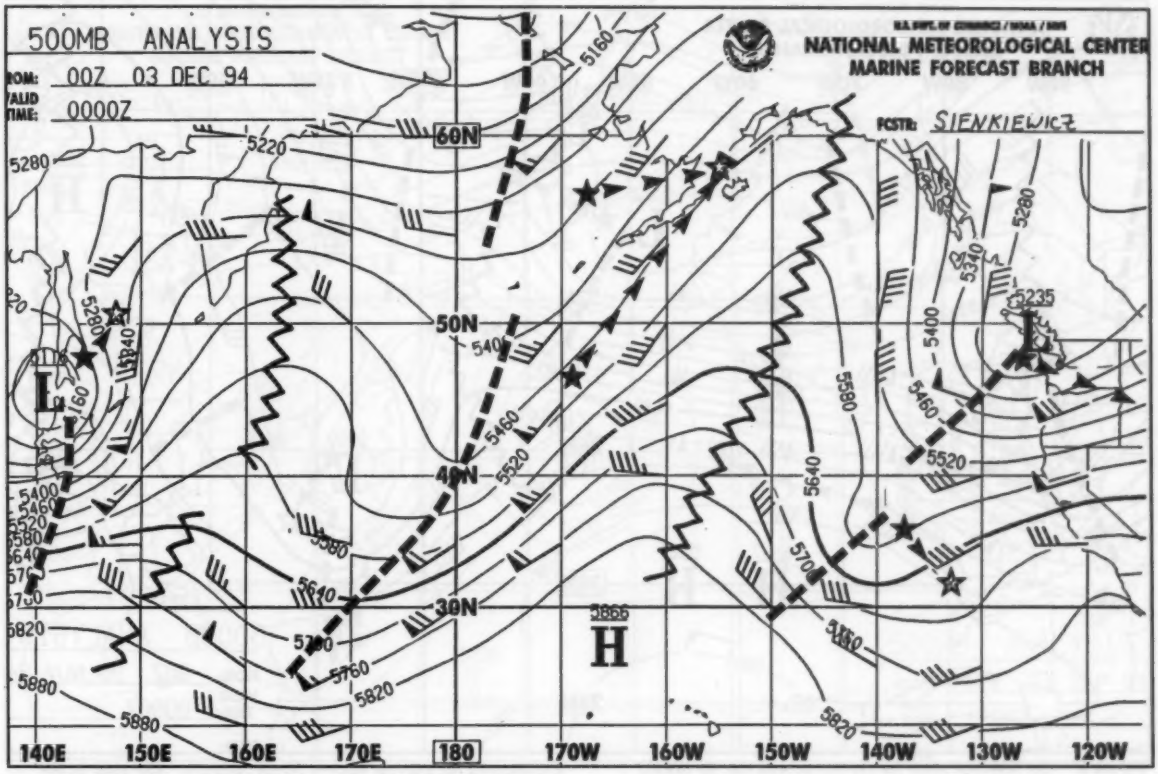


Figure 5. The observed 500-mb chart is for the North Pacific at 0000Z December 03, 1994 and shows a meridional pattern.

Meridional patterns tend to move cold air south and warm air north.

Meridional Pattern

In a meridional pattern the contours have more amplitude (north-south orientation) than in a zonal flow (see the example from the North Pacific in Figure 5). Meridional patterns tend to move cold air south and warm air north. Surface lows and 500-mb short waves will move more toward the north or south than in a zonal pattern (along a meridian). Look at the 24-hour tracks in this example. The surface low at 47°N, 169°W moved northeastward at 30 knots to just off Kodiak Island. The low and short wave trough west of California moved southeastward. The surface low, associated with a closed low north of Japan, moved slowly northeastward. A large ridge extends from Alaska to west of Hawaii and northerly flow east of the ridge brings cold air southward from interior British Columbia and Northwest Territories out over the waters west of the Pacific Northwest. Southwesterly flow is moving warm moist air from south of 30°N near 170°E northeasterly toward Alaska.

The concept of different streams can easily be seen on this chart. East of Japan the northern stream weakens as it moves over a ridge along 160°E. The southern stream is stronger west of 170°W and less amplified than the northern stream. Farther east the northern stream is stronger in the northerly flow east of 140°W with a weaker southern stream trough near 35°N, 140°W.

The stream concept is important because the interaction between short waves embedded in different streams and in particular where the short waves phase together are areas for potentially significant surface low development.

Remember that the 500-mb field is in motion. Therefore, it is a good idea to look at the 500-mb forecasts to see how the pattern is expected to evolve. It is not unusual to have a progressive meridional pattern where short wave troughs and ridges, although they are amplified, continue their eastward progression. In the fall of 1994, both the Atlantic and Pacific had strong, progressive meridional patterns.

Blocking Pattern

A high amplitude ridge that blocks the west to east progression of the westerlies is aptly named a

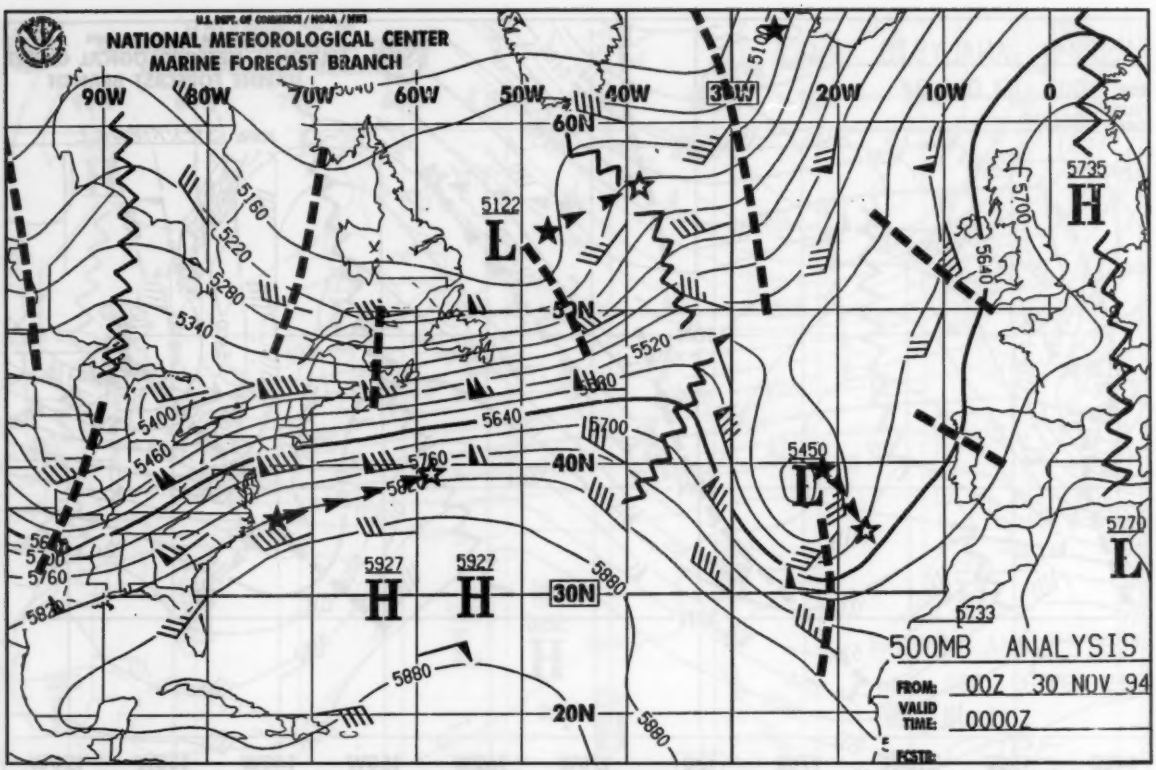


Figure 6. The 500-mb chart for the North Atlantic for 0000Z November 30, 1994. This chart shows a blocking pattern over Europe and the extreme eastern North Atlantic. The split in the westerlies can be seen at 50°N, 25°W.

blocking ridge. Figure 6 shows a blocking pattern with a large ridge blocking the westerlies over western Europe and the eastern North Atlantic.

In a blocking pattern, short waves will be steered northward or northeastward over the blocking ridge. If the amplitude of the ridge is large enough, then short wave troughs approaching from the west may try to undercut or drive under the block. This undercutting helps to set up a split in the westerly flow to the west of the blocking ridge and eventually helps to break down the block.

In Figure 6 the split in the westerlies can easily be seen near 50°N, 25°W. The 5450-meter closed low near 38°N, 24°W is a result of the westerlies trying to undercut the blocking ridge. Due to the strength of the northwest flow to the west and northwest of the 500-mb low, the low is said to be "digging" to the southeast. Thus the surface low and 500 mb both move southeastward.

Closed lows that form to the west of a blocking ridge and dig southeastward tend to be fairly strong and it is not unusual to have surface winds at 45 to 50 knots to the west and southwest of the surface low.

Two lows near Iceland and south of Greenland are moving northeastward and north northeastward due to the blocking ridge to the east. Blocks may last 10 days or more.

Cutoff Lows

If a 500-mb pattern becomes amplified enough then it is possible for a low to form on the southern boundary of the westerlies and become "cut-off" as shown in Figure 7. The closed circulations associated with the lows over eastern Kansas, the mid Atlantic (40°N, 45°W) and Spain are cutoff from the main stream of zonal westerlies north of 55°N. Weak ridging separates the higher latitude westerlies from the three cutoffs. Cutoffs tend to remain stationary and persist for several days. They may be accompanied at the surface by strong winds (in particular, in the north to northwest flow to the west of the developing low), showers, and thunderstorms. Also, it is not unusual to have strong easterlies to the north and northeast of the center due to the strong pressure gradient between the cutoff and strong surface high to the northeast or east. Cutoffs either gradually weaken or are picked up by the higher latitude westerly flow when the pattern amplifies again and the capping

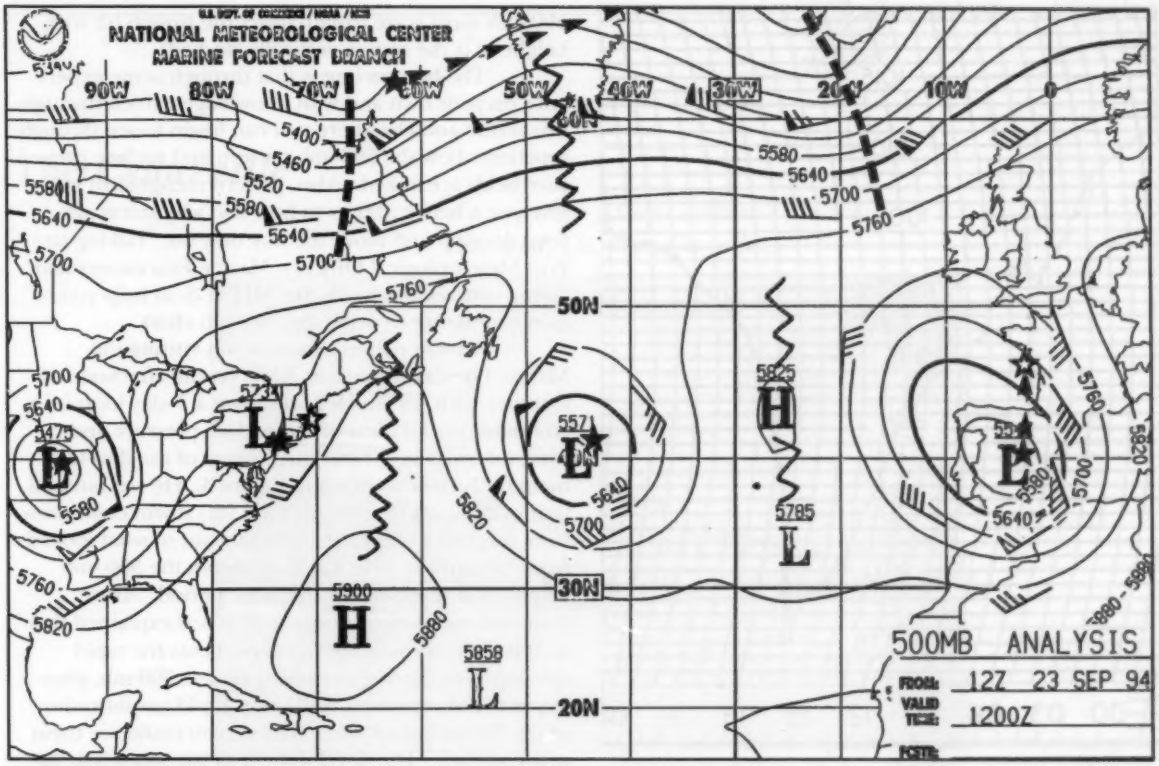


Figure 7. This 500-mb analysis for the North Atlantic at 1200Z September 23, 1994 shows three cutoff lows. These systems play a significant role in any surface features beneath them. Cutoff lows tend to persist and remain stationary for several days. They are often accompanied by strong surface winds to the west of developing surface lows.

ridge breaks down. They tend to occur most in the spring and fall when the westerlies migrate north and south, respectively.

These are just samples of several basic 500-mb patterns. At any given time a variety or combination of patterns may exist over an ocean basin. It is not unusual in the Pacific to have strong zonal flow over the western Pacific with a meridional or even a blocking pattern over the eastern Pacific.

Derivation of the 500-mb Height Field

You might wonder how the 500-mb height field is determined over the oceans. Globally, each day at 0000 and 1200Z over the continents, at selected island sites, and on several specially equipped merchant ships, weather balloons are launched to sample the vertical structure of the atmosphere. One of the mandatory levels at which the height, wind, temperature, and humidity data are measured is the 500-mb level. Although balloon data is scarce over the oceans, ship surface weather observations, commercial aircraft reports at jet stream level and satellite derived moisture profiles and wind estimates are all combined and quality-controlled to help determine the initial state or three dimensional structure of the atmosphere over the oceans. In addition, 6-hour forecasts from the operational computer forecast models are used as a first estimate as to the initial state of the atmosphere. Think of all the global observations being used to tweak the previous computer model forecasts in the right direction, which makes for relatively consistent model forecasts. Note that your ship observations have an impact in determining the three dimensional structure of the atmosphere.

The highly sophisticated operational forecast computer models that simulate the atmosphere are then run using the analysis determined from a combination of the observed data and previous model forecasts. The 500-mb height fields from the analysis process and 48- and 96-hour forecasts from the NMC Global Spectral Model are transmitted via radiofacsimile. Studies have shown that 500-mb forecasts tend to be more accurate than surface pressure forecasts.

The Bottom Line

One way to use the 500-mb charts is to set up

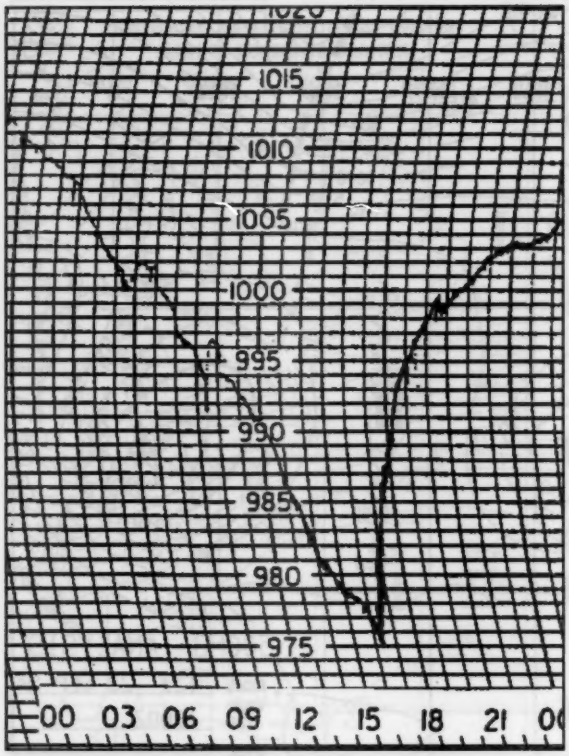


Figure 8. Barograph trace from ***President Washington*** *enroute from Oakland, CA to Guam for October 13, 1994. Its pressure was 10 mb lower than was analyzed on the 12Z chart.*

a display of both surface and 500-mb analyses along with the 48- and 96-hour forecasts in the chartroom or on the bridge.

You may want to outline the wind maxima associated with each trough expected to affect you and gain experience that way. Is the wind maximum to the west, evenly distributed or to the east of the short wave trough? In other words will the trough dig, lift out, or just stay steady state in the overall flow? Take a look at the previous forecasts. Are there any big changes from the earlier series of surface and 500-mb analyses and forecasts to the current series?

Remember that the 500-mb pattern and specific short waves are linked and associated with the motion and life cycle of surface storm systems. Look at the progression of the 500-mb pattern from analysis time to 48 hours to 96 hours. Is the pattern becoming more meridional, zonal, or blocked over the next 4 days? Next look at specific short waves and associated surface features that will be affecting you over the next several days. Think of the examples in the article. You may want to mark the position of surface lows on the 500-mb chart to see how the surface low relates to the 500-mb short wave trough (does the trough tilt with height or is the system vertically stacked).

The bottom line is that through some experience on your own and with knowledge gained through this article and elsewhere you can begin to see through repetition how the 500-mb pattern and surface pressure fields are linked. Also, pattern recognition will give you a better idea as to how and why storm systems develop and move the way they do. Talking to Port Meteorological Officers, Marine Forecasters and taking courses at schools like MITAGS all help you to gain experience in using the 500-mb chart.

A yacht delivery captain was visiting the Marine Forecast Branch at NMC on the afternoon of October 12th, 1994. He was shown a 3-day loop on a computer workstation of the surface pressure and wind forecasts in 6-hour increments of the development of the storm shown in Figure 3. He was amazed that in 24 hours (by 12Z on the 13th) storm conditions were forecast to develop so rapidly out of what looked like a benign low. He was then shown the 500-mb height field forecasts for the same period. As we reviewed each forecast time step, it was explained that at 500 mb you could see the ingredients for rapid development (strong northwest flow at 500 mb, phasing of two short waves, and sharp rapid amplification of the 500-mb short wave) before you could see them at the surface. The development of the storm was no surprise, however, even the computer model forecast was too slow at deepening the storm system.

American President Lines' ***President Washington*** went through the center of this low at approximately 1630Z on October 13. Its barograph trace (Figure 8) showed a central pressure of 975 mb with an extreme pressure rise to the west of the storm center. The 975-mb central pressure was 10 mb deeper than the 985 mb indicated on the 12Z October 13 analysis. The ***President Washington*** also experienced 55-knot winds to the west of the occluded front shown at 12Z October 13. While 500-mb analyses and forecasts don't always provide the answer, a much clearer picture of the surface weather conditions is presented with a knowledge of conditions at both levels.

No matter how you receive weather information a basic understanding of 500-mb patterns and relationships to the surface pressure field will help you make more educated decisions for a safe and economical transit.

The *Cedarville*

Skip Gillham
Vineland, Ontario, Canada

Dave Glick

*The **Cedarville**– photo courtesy of Milwaukee Public Library*

Light fog thickened as ***Cedarville*** approached the narrow Straits of Mackinac connecting Lake Huron and Lake Michigan. First launched on April 9, 1927, the 184.5–meter long steamer was a straight deck bulk carrier until 1956 when it was rebuilt as a self-loader.

Cedarville's final voyage on May 7, 1965, began at Calcite where it cleared with 14,411 tons of limestone for the U.S. Steel dock at Gary, Indiana.

The ship's radar picked up other vessels in the area, and radio communication was established with the German freighter ***Weissenburg*** who noted a Norwegian freighter ahead. This came as a surprise to the crew of ***Cedarville*** as they thought this radar return was from the German freighter.

Attempts to reach the second freighter via radio were unsuccessful, and suddenly the ***Cedarville*** had to pursue evasive action as the bow of the Norwegian ***Topdalsfjord*** loomed out of the mist. At about 0945 hours, the freighter met the port side of ***Cedarville*** just aft of the seventh hatch.

Cedarville stopped its engine and dropped anchor to survey the damage and found water pouring through a massive hole above and below the waterline.

In an attempt to save the vessel, the anchor was lifted and it was run at full speed for the shallow water. Only 15 minutes of life remained, and it was not enough. At 1025 hours ***Cedarville*** rolled on its starboard side and sank in 31 meters of water. Some sailors were trapped on board while others perished in the cold lake. The ***Weissenburg*** followed the stricken ship on radar and picked up 27 sailors, but two of those later died. Ten lives were lost in that hopeless maneuver when the ship rolled over and sank. A thorough and complicated investigation followed. It was, for the most part, critical of the speed and maneuvers aboard ***Cedarville*** and the Captain's license was suspended for one year.

Topdalsfjord apparently still survives as ***Jin Xian Quan*** for China Ocean Shipping. ***Weissenburg*** had a 33–year career and was scrapped in Pakistan in 1986.

This story is one of many from Skip Gillham's recent book Seaway Era Shipwrecks, *available from Riverbank Traders, 57 Main St., St. Catharines, Ont., L2N 4T8.*

Heavy Weather Avoidance

Glen Paine
Maritime Institute of Technology and Graduate Studies

Even with the recent advances in ship construction and technology, hundreds of vessels are still lost each year due to heavy weather. In 1993 alone, weather caused the loss of over 200,000 gross tons of ship capacity (*Professional Mariner* Oct/Nov. 1994). When ship, crew and cargo damages are added to the total ship losses, the cost due to weather is in the millions of dollars.

Minimizing the time the vessel spends in the storm track is the key to reducing weather related damages. Though the concept is simple, implementing it is difficult due to the number of conflicting objectives placed upon a ship's master. The Captain is constantly seeking a balance between maintaining an adequate margin of safety (by avoiding adverse wind and seas) and reducing transit times and costs.

Generally, a six-step decision-making process is needed to balance these conflicting objectives. Of all the steps listed below, arguably, evaluating the present and future significant weather features is the most difficult. Many different resources can be used to assist in this task. They include private routing and computer services, climatic data (pilot charts, sailing directions, etc.), satellite imagery, NAVTEX, voice broadcasts and facsimile charts.

Route advisers and computer programs are excellent but usually require a subscription for their services. Climatic data (such as pilot charts) are also excellent for developing "rules of thumb," but not for the immediate weather. NAVTEX, voice and satellite

Six Steps to a Routing Decision

1. Determine the vessel's motion limits, which can vary depending on vessel, crew and cargo characteristics. Routes that are valid from a weather standpoint may be completely unacceptable due to the unique situation of the vessel.
2. Evaluate the present and future weather conditions with all resources available.
3. Calculate the shortest distance route. All things being equal, this is the route to beat.
4. Estimate alternative routes that seek to take advantage (or minimize the disadvantage) of wind, sea, topographical or current conditions.
5. Adjust routes to take into account navigational restrictions (ice, load lines, traffic, draft, etc.).
6. Decide whether one of the alternative routes better satisfies the objectives of the vessel than the shortest distance route.

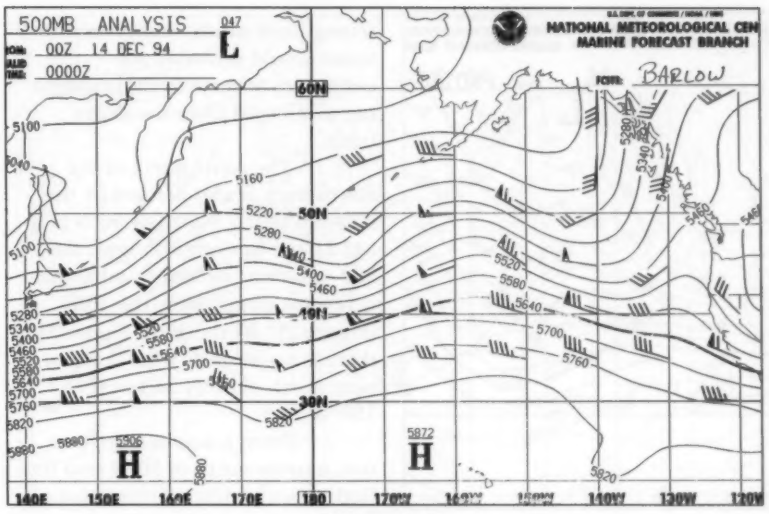


Figure 1

imagery provide good information on present weather but have difficulty conveying future conditions over large areas.

Weather facsimile analyses and prognoses charts are ideal for portraying present and future weather. Upper air charts when used in conjunction with the surface charts provide an enormous amount of information about present and future movement of significant weather features. They also provide ways to assess their accuracy.

Confidence in forecasts is especially important to a ship since a vessel may have to commit to a routing scheme early into the voyage. A vessel generally cannot outrun fast-moving weather systems. In addition adverse wind and sea conditions reduces the ability of the ship to change its position relative to the storm.

Reliability of facsimile charts can be appraised in several ways. First, compare your ship's actual weather to what is depicted on the analysis chart (for the same time period). Assuming your observation is accurate, this is a rough indication of the accuracy of the data used to create predictions. If the initial data is bad, it is likely that forecasts might also be a bust.

Compare past prognoses to the actual analysis. If the forecasts have been accurate in the past, you can infer that this accuracy should continue for some time into the future.

Factors such as pattern type, time of year and consistency with historical data (pilot charts) can also help in assessing forecast reliability. Certain weather patterns develop in the spring and fall that make forecasting extremely difficult. However, if forecasts fit the historical patterns for the season and region, the accuracy of such predictions is somewhat enhanced.

Figure 1 is an example of the 500-millibar (mb) charts broadcasted daily by the National Weather Service. Other private and government weather services provide similar charts. These charts depict the wind direction and speed at positions where all pressure is equal to 500 millibars. Just as on the surface, atmospheric pressure at any given location is a function of the moisture and temperature properties of the particular air mass. Lines of equal altitude ("height contours") are drawn on the chart, at 60-meter intervals, similar to lines found on topographic maps (see Sienkiewicz and Chesneau article on page 4 for further description of the 500-mb chart).

The analysis, in Figure 1 is

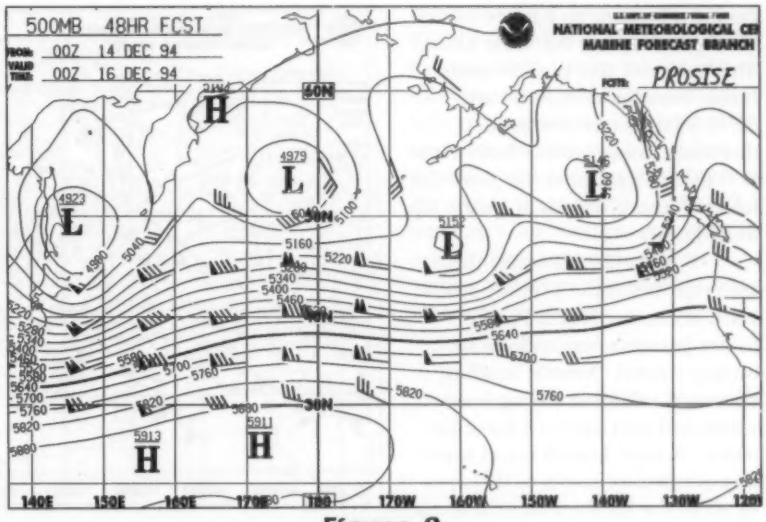


Figure 2

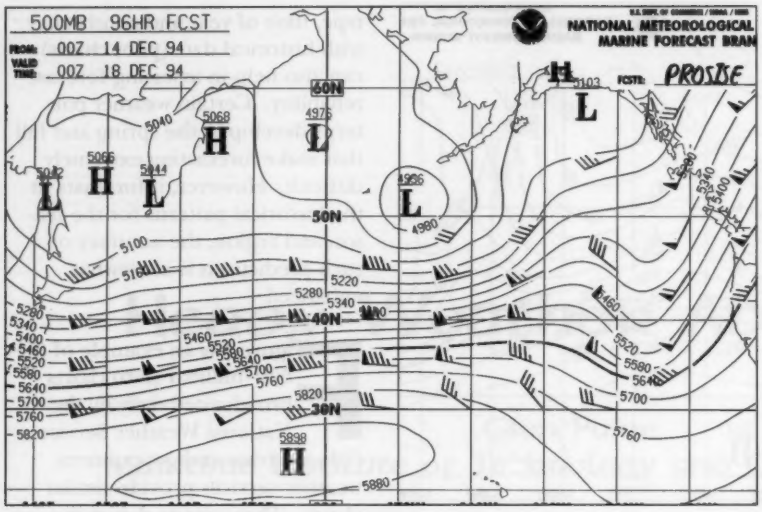


Figure 3

based on weather data collected at 00Z, on December 14, 1994. The analysis is followed by 48-hour (Figure 2) and a 96-hour (Figure 3) prognoses charts that are based on the 00Z data. All charts are broadcast within 12 hours of the initial analysis. Similar charts are available for the North Atlantic.

A review of these charts indicates a zonal (west to east) upper-air wind flow for the next 4 days across most of the North Pacific (changing to a more meridional pattern near the West Coast). This indicates that present and future lows between 30°N and 50°N will move in this general direction. Since surface lows move at ⅓ to ½ of the upper-air flow, the lows will move zonally at speeds up to 50 knots.

Not coincidentally, this area represents the primary storm track across the North Pacific (other patterns may include secondary tracks). Vessels heading westward will incur strong head winds and seas between these latitudes. A west-bound vessel must transit north or south of this area to avoid the harshest wind and sea conditions.

Routing below the prevailing storm track is quite easily determined using the 500-mb chart. Note the highlighted contour value (5640 meters) on Figures 1 through 3. Experience tells us that storms of force 7 or greater generally track north of this line in the winter (force 6 in the summer). A vessel would have to transit several degrees below this line to avoid the strong head winds. However, the vessel would probably still encounter adverse swells propagating southward from the storm track.

The route north of the storm track is also defined by the 500-mb chart. North of 50°N (Figure 1), the westerly winds on the 500-mb chart decrease and actually reverse direction by the 16th (Figure 2). By the 18th (Figure 3), there is no westerly wind component north of 50°N and west of 150°W.

From a weather perspective, a route north of 50°N into the Bering Sea is clearly favored for a vessel westbound from Seattle to Japan. Once across the Gulf of Alaska, the initial force 6-7 winds (Figure 4) diminish and change from head westerlies to quartering easterlies (force 4-5) by the 16th (Figure 5). By the 18th (Figure 6), a fast ship should be in the Bering Sea topping the 953-mb low (51°N, 169°W). Note the adverse force 10 to 12 westerlies between 35°N and 48°N in the Central Pacific. By early recognition of the zonal pattern in the upper air, the vessel can be positioned to avoid the adverse headwind conditions in

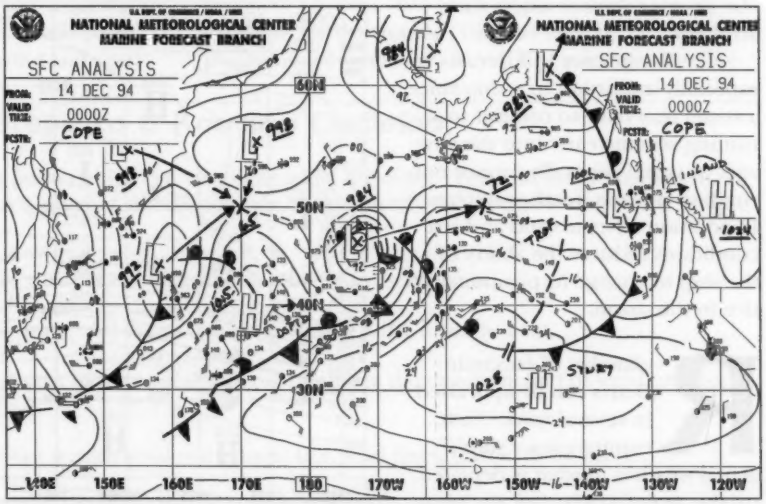


Figure 4

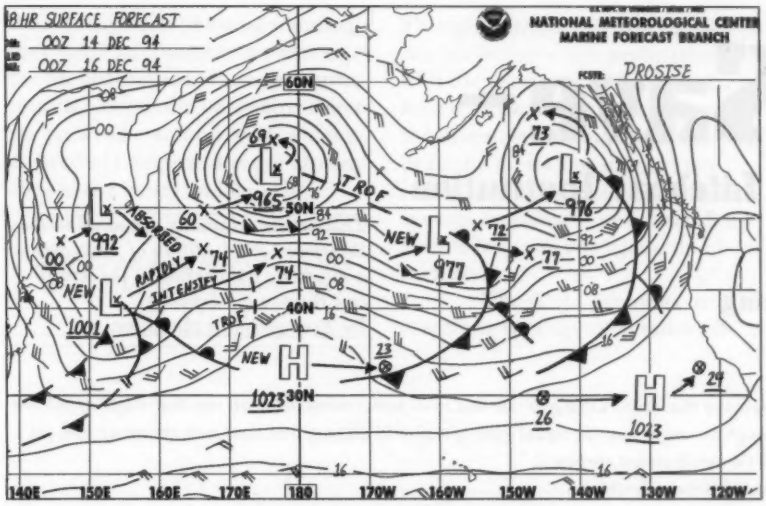


Figure 5

the Central Pacific.

Given the amount of energy in the upper-air patterns well to the south, it is also likely that any new lows that develop will move to the south of the vessel's track. If for some reason, the weather patterns did veer northward, the vessel would still have the option of using the Aleutian Chain to limit the fetch of developing seas.

If a vessel decided to run south, it would be placed directly into the storm track. The ship would encounter one low after another until retreating below 30°N. This could cause extensive time delays, and increased weather-related costs.

Looking at the 96-hour surface forecast (Figure 6) we can see that a vessel south of 50°N in the central Pacific would be getting hammered by the 953-mb low (51°N, 169°W). The large fetch and storm winds (50 knots or more) would be generating tremendous seas. The dense cold air being pulled down from the Arctic on the back side of this low would further increase sea state development.

The 500-mb chart is also an excellent tool for determining whether existing or new surface lows will develop or diminish, surface highs will become transitory or stationary and how general routing recommendations compare to existing weather conditions.

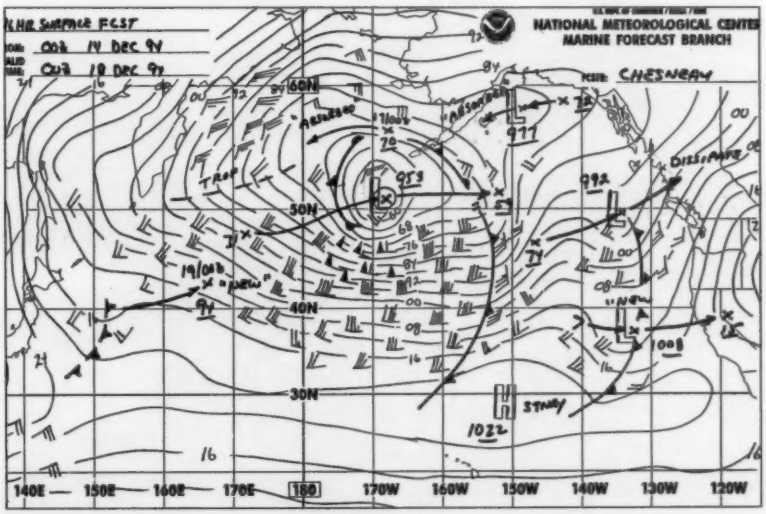


Figure 6

Upper-air patterns do repeat themselves. This particular pattern favors "over the top" routing. By analyzing the various patterns, one can build up a log listing which patterns favor certain routes. (Look for additional articles on the use of the NWS facsimile charts in future editions of the *Mariners Weather Log*.) The closer the actual flow patterns are to your recorded patterns, the more likely similar weather will develop.

In this article, I have just touched on the basic benefits of the 500-mb charts. Take the time to read other articles on the use of this chart, and add upper-air pattern recognition into your routing decision-making process. Over time you will develop confidence in the use of these charts. They will become valuable tools that complement other resources used to reduce the impact of weather on vessel operations.

Strong to Save–

The Royal National Lifeboat Institution

Joe Evangelista
American Bureau of Shipping

This article originally appeared in the September 1994 edition of Surveyor– *a quarterly publication of the American Bureau of Shipping. Joe Evangelista is the editor.*

These are among the bravest and most skilful mariners that exist. Let a gale rise and swell into a storm; let a sea run that might appal the stoutest heart that ever beat ... let them hear through the angry roar the signal guns of a ship in distress, and these men spring up with an activity so dauntless, so valiant and heroic, that the world cannot surpass it."
–Charles Dickens, on Britain's Royal National Lifeboat Institution

Lauded by Dickens and lionized by Churchill, the Royal National Lifeboat Institution (RNLI) has won admiration from nine generations of seafarers and other grateful souls throughout the British Isles. Established in 1824, it is a privately–run volunteer organization whose lifeboat crews have saved the lives of more than 125,000 people imperiled by everything from boating mishaps on sunny days to shipwrecks in storms with hundred–knot winds. Last year alone, the RNLI made 5,568 emergency launches and saved 1,308 people, an average of 15 launches and three rescues every day.

The RNLI's unpaid lifeboat crews have possibly the most unenviable mandate in Britain: to be prepared to launch into a sea that has already frightened off every able ship and to rescue the crews of those left behind. Though many coastal towns have a generations–long tradition of RNLI service, there is no compulsion on anyone to serve from other than their own free will. Though independent of government, the organization does cooperate with the British Coastguard, which often functions somewhat like a dispatcher receiving an SOS and deciding which emergency service to call. The RNLI in fact functions very much like the "lifeboat department" of the Coastguard's search and rescue division.

Over the last 170 years, more than 400 rescuers have lost their lives attempting to save others.

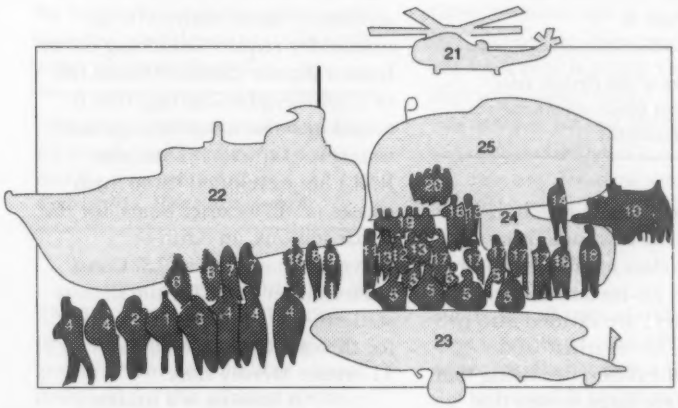
The lifeboats are manned by some 3,500 brave men and women in 212 coastal towns around Great Britain and Ireland. Over the last 170 years, more than 400 rescuers have lost their lives attempting to save others. At any moment, their normal, daily routine may be interrupted by the sound of a beeper calling them to duty. Where once the crews were largely fishermen, today they come from all walks of life. No matter

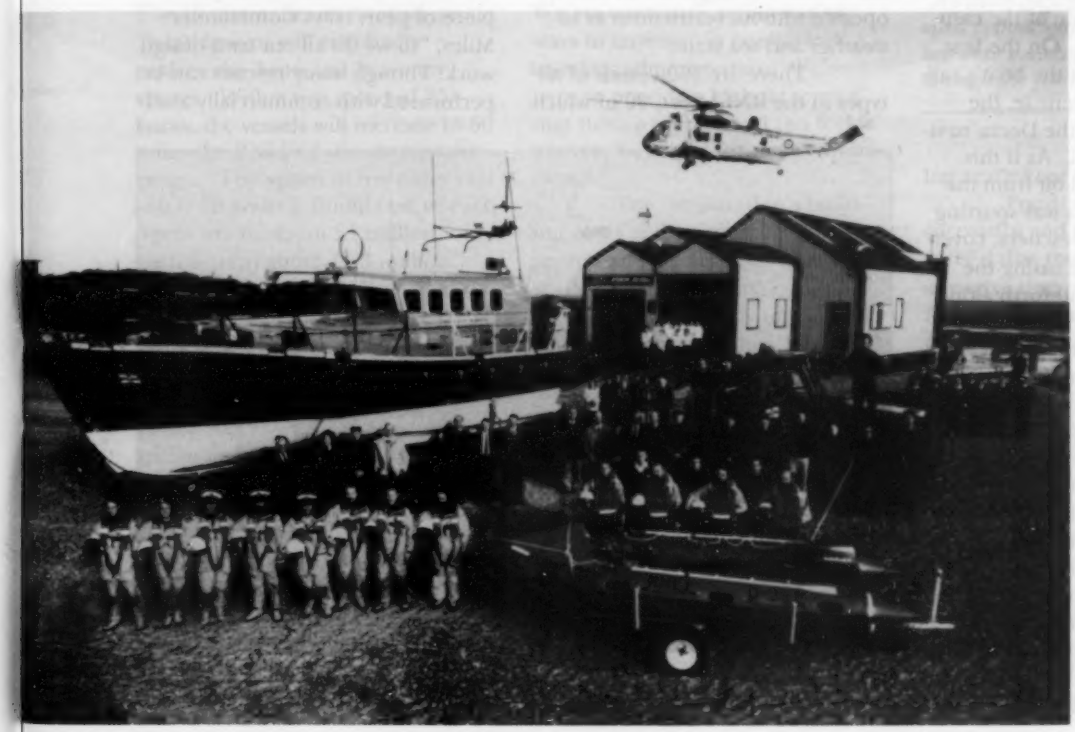
their occupation or social standing, they share in common the race to the lifeboat station when the alarm sounds. There the coxswain selects the crew, who suit up, grab whatever needed equipment is not already aboard the vessel and launch.

The RNLI promises to reach any spot up to 30 miles offshore within 2 hours ... .

Though hurried, this is no amateurish frenzy – it is performed with the precision and speed of a military squadron, mainly due to the intensive training and weekly drills the crews and support personnel receive. Because of this, the average response time from call to launch for a sea emergency is 14 minutes.

The RNLI promises to reach any spot up to 30 miles offshore within 2 hours, and further timely coverage to within 50 miles. There have been times when disasters, such as the crash of an Air India jetliner off the Irish coast in 1985, have called the crews to venture much further. They are prepared for this–in fact, the cruising range of their largest vessels, the 16–meter Arun class, is 230 miles. While many emergencies occur within 10 miles of shore, and a





The Wells lifeboat station lifeboat crew and shore support team (left). This station has a Mersey class lifeboat and a D class inflatable. 1. Coxswain/Mechanic, Mersey class lifeboat 2. Second Coxswain, Mersey 3. Assistant Mechanic, Mersey 4. Crew, Mersey 5. Helmsman and crew, inflatable lifeboat, 6. Honorary secretary and wife 7. Deputy launching authorities 8. Honorary medical advisor 9. Honorary treasurer 10. HM Coastguard sector officers and auxiliaries 11. Branch chairman 12. Ex-coxswain 13. Branch committee members 14. Deputy head launcher 15. Tractor driver 16. Assistant tractor driver 17. Launchers 18. Shore helpers 19. Ladies Lifeboat Guild members 20. Local lifeguards 21. Sea King helicopter, RAF Leaconfield 22. Mersey class lifeboat 23. D class inflatable Lifeboat 24. Talus MBM launching tractor 25. Lifeboat house

very large proportion in comparatively good weather (to the RNLI, anything less than a gale force wind is "comparatively good"), each year a large number of calls bring the crews out in truly terrifying conditions.

One of the citations given at this year's RNLI awards ceremony provides an illustration. On a November night in 1993, an SOS went out to the British Coastguard from a Russian factory ship that had run aground on Unicorn Reef in the Shetland Islands. In a full gale of storm force 10, the ship was bashing about on the rocks, rolling and pitching and certain of destruction. The Coastguard dispatched a helicopter, which in turn asked for assistance because there were 74 people stranded aboard the stricken vessel. The Coastguard alerted the lifeboat station in Lerwick, Scotland.

Lerwick's Arun class lifeboat went out to the rescue. On those massive waves, the lifeboat rose and fell 6 meters at a time, smacking into the side of the casualty with each heave. On the first hit a fender took out the boat's railings and satellite antennae, the shock knocking out the Decca navigation system as well. As if this weren't enough, fuel oil from the ship's ruptured tanks was spurting in streams over the rescuers, covering the lifeboat and causing the crew to slide back and forth along the deck. On top of it all, the Russians waiting to be rescued were absurdly throwing their suitcases down onto the lifeboat crew all in the middle of the night in a full gale! Despite all this, the coxswain guided the boat alongside the ship 35 times, the crew plucking 37 seafarers from the end of a jumping ladder dangling amidships 9 meters in the air. For his heroic determination, coxswain William Clark was awarded a bronze medal.

"Medals are taken very seriously indeed in the RNLI," says Lieutenant Commander Brian Miles, RNLI Director. "Out of about 5,500 calls a year, roughly 30 will get special recognition. On average, a gold medal for supreme gallantry goes about every 5 years—it's called the lifeboat man's Victoria Cross; a silver medal, about every 2 years; and a bronze, about four or five times a year. Winning a medal is a tremendous honor in the Lifeboat Service. The standards for medals are very high, and when they get one they know they've earned it."

The coastline of the British Isles doesn't always place safe harbors in convenient locations.

The boats in which they race to the rescue range from 5-meter D-class inflatable motorboats to the 16-meter Arun class cutters. These are divided into two categories: "all-weather" and "inshore," the difference being that the former are large vessels that operate without restrictions as to weather and sea state.

There are 360 vessels of all types in the RNLI fleet, 90 of which are held available as relief for vessels in need of service or due for inspection. With two exceptions, all types have been designed by RNLI naval architects and engineers. These designs accommodate different types of rescue work and the demands the local shoreline puts on launching.

The coastline of the British Isles doesn't always place safe harbors in convenient locations. While 72 stations allow the all-weather lifeboats to remain in the water at all times ("afloat stations"), the remainder require launching either from a slipway (about 30 stations) or a submergible carriage that is towed into the water by a special waterproof tractor. Thus, the RNLI has developed three main classes of all-weather boats: for the afloat stations, an Arun or Waveney (based on a U.S. Coast Guard cutter class; for the slipway stations, the 14-meter Tyne class; for the carriage stations, the 11-meter Mersey class.

"A lifeboat is a unique piece of gear," says Commander Miles, "so we do all our own design work. Though many rescues can be performed with commercially avail-

The 11-meter Brede is one of 360 vessels of all types in the RNLI fleet.

able craft, we must think of the most horrendous cases and design the ships accordingly.

"When it's 3:00 in the morning and it's blowing an absolute hurricane and the crew gets a call from the Coastguard, they must launch. And at that moment there's nothing more we can do for them. They must have the equipment at hand and must go to sea feeling—if they feel anything—that we have bust a gut to give them the best equipment, the best training, the best boat available...they must have the confidence that the tools won't let them down."

"When its 3:00 in the morning and it's blowing an absolute hurricane and the crew gets a call from the Coastguard, they must launch.

Pursuing this thinking, the RNLI at this time is embarking upon an ambitious building program for two new lifeboat classes designed for the afloat stations. The 17-meter Severn and 14-meter Trent designs will eventually replace the Arun and Waveney classes. With a top speed of 25 knots, the vessels will increase to 50 miles the RNLI's 2-hour response range. (Top speed of the older vessels is 18 knots.) Initial cost of each Trent will be about £1 million, of each Seuern about £1.3 million. Miles estimates the RNLI will need about 90 total, including relief units. The program will continue into the next century.

There is also a building plan underway for the inshore fleet, where the twin-engined, 6-meter inflatable Atlantic 21 class will be replaced by an updated version called the Atlantic 75, which is capable of 34 knots as compared to 29 for the older boat. "There are 50-odd 21 in service," says Miles, "and we plan that by the end of the century half the stations will have 75s, with the program complete by 2006. It's all part of our rolling 5-year strategic plan. We can never just lie back contentedly and say we've got it pretty perfect now. We are constantly trying to find ways to improve, in equipment, training, administration. We're here to provide a lifeboat service that Britain and Ireland can feel is in every way right for their requirements."

The organization's building plans and training programs represent a tremendous financial commitment. Running costs for the RNLI in 1994 may top £56 million. What is even more impressive is that this sum and more will be raised entirely through private contributions solicited by a virtual army of dedicated, volunteer fundraisers.

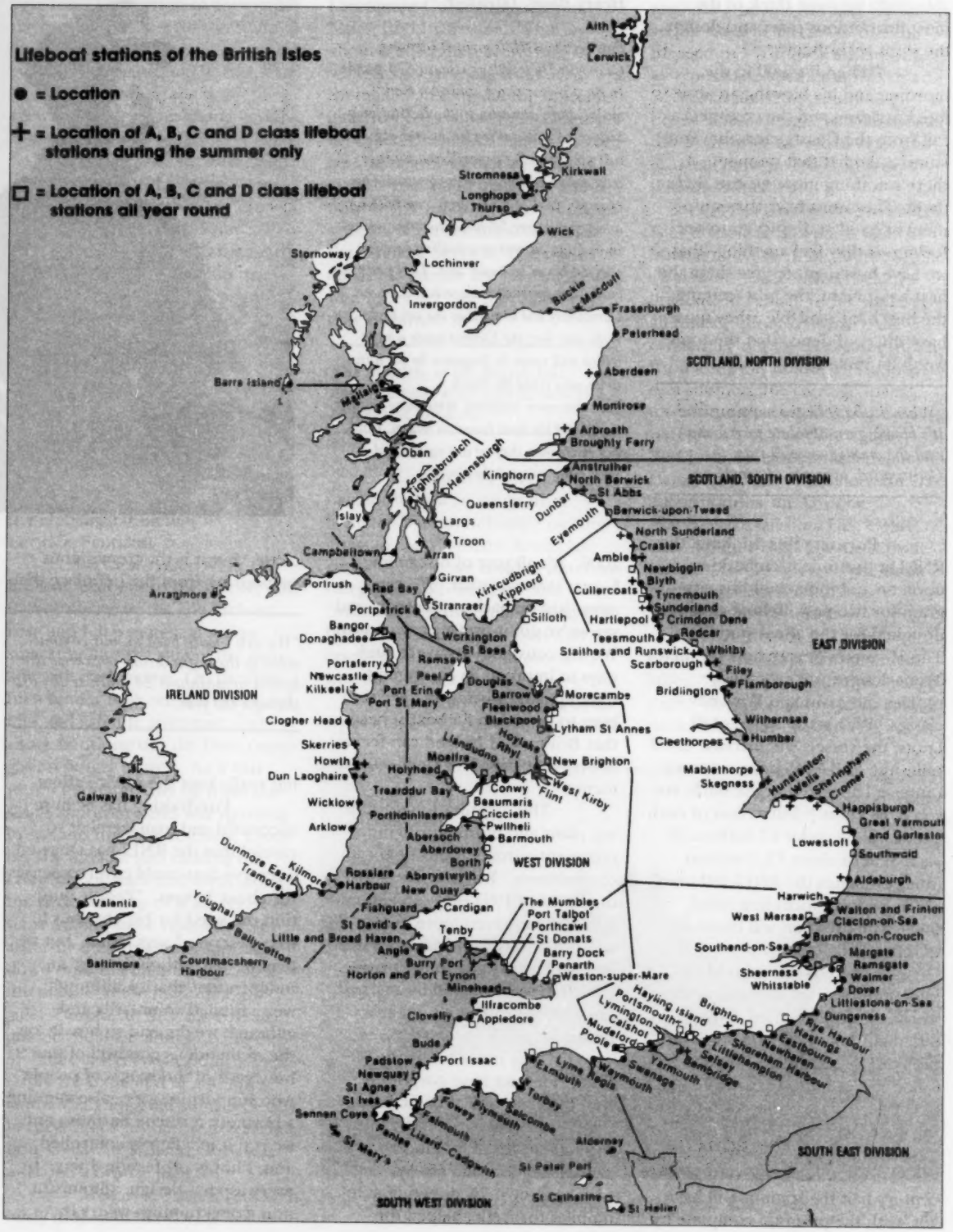
That is not to say the RNLI does not have corporate supporters as well. For example, the Royal Bank of Scotland, through an RNLI credit card, donates a good sum yearly; likewise has Volvo, by donating automobiles for raffle, helped the cause. But it is the tremendous outpouring from the populace that has really kept the service afloat.

"We can't walk back on our commitment to these standards, which we are bound to maintain 24 hours a day all through the year."

Fundraising has been so successful and management so careful that the RNLI has amassed a reserve that could cover expenses for about 3 years. "People question the need for big charities to have reserves," says Miles, "but we believe that, although we're an independent charity, although we're funded voluntarily and although we depend so heavily on the tremendous goodwill of the hundreds of thousands of people who support us, we're also running a business, a rescue business, and we run it in a tightly controlled and, I hope, professional way. In every aspect—design, administration, crew training—we try to

Henry Blogg, Lifesaver

Possibly the RNLI's greatest lifesaver, Coxswain Henry Blogg rescued 873 people. In his 53-year career and won more medals than any man in the Institution's history. A natural leader, he was able to call up reserves of strength and courage most men never knew they possessed. One example: in 1917, he and a crew with an average age over 50 performed two rescues in one day, manning a pulling boat for over 14 hours in heavy seas. They first rescued 16 men from one wreck and set out. Completely lost to sight as the sea broke right over her, the lifeboat made a sight which will never be forgotten by the hundreds who lined the beach.
Five oars were smashed, three more washed away and the boat forced to return. Finding spare oars they set out again and, incredibly, rescued the eleven.


Lifeboat stations of the British Isles
● = Location
+ = Location of A, B, C and D class lifeboat stations during the summer only
□ = Location of A, B, C and D class lifeboat stations all year round
Alth
Lerwick
Stromness
Kirkwall
Longhope
Thurso
Wick
Stornoway
Lochinver
Buckie
Macduff
Invergordon
Fraserburgh
Peterhead
SCOTLAND, NORTH DIVISION
Aberdeen
Barra Island
Montrose
Arbroath
Broughty Ferry
Oban
Tighnabruaich
Helensburgh
Kinghorn
Anstruther
North Berwick
St Abbs
SCOTLAND, SOUTH DIVISION
Queensferry
Dunbar
Eyemouth
Berwick-upon-Tweed
Islay
Largs
Troon
Arran
Campbeltown
North Sunderland
Crastor
Amble
Newbiggin
Blyth
Tynemouth
Sunderland
Cullercoats
Hartlepool
Crimdon Dene
Redcar
Teesmouth
Staithes and Runswick
Whitby
Scarborough
Filey
Flamborough
Bridlington
EAST DIVISION
Withernsea
Cleethorpes
Humber
Mablethorpe
Skegness
Hunstanton
Wells
Sheringham
Cromer
Happisburgh
Great Yarmouth and Gorleston
Lowestoft
Southwold
Aldeburgh
Harwich
Walton and Frinton
Clacton-on-Sea
West Mersea
Burnham-on-Crouch
Southend-on-Sea
Margate
Ramsgate
Sheerness
Whitstable
Walmer
Dover
Littlestone-on-Sea
Dungeness
Rye Harbour
Hastings
Eastbourne
Newhaven
Shoreham Harbour
Littlehampton
Selsey
Bembridge
Yarmouth
Brighton
Hayling Island
Portsmouth
Lymington
Calshot
Mudeford
Poole
Swanage
Weymouth
Lyme Regis
Exmouth
Torbay
Salcombe
Plymouth
Fowey
Falmouth
Penlee
Lizard-Cadgwith
St Mary's
Sennen Cove
St Ives
St Agnes
Newquay
Padstow
Port Isaac
Bude
Clovelly
Appledore
Ilfracombe
Minehead
Horton and Port Eynon
Burry Port
Penarth
Barry Dock
Weston-super-Mare
St Donats
Porthcawl
The Mumbles
Port Talbot
Tenby
Little and Broad Haven
Angle
St David's
Fishguard
Cardigan
New Quay
Aberystwyth
Borth
Aberdovey
Abersoch
Barmouth
Pwllheli
Criccieth
Porthdinllaen
Beaumaris
Conwy
Flint
West Kirby
Trearddur Bay
Holyhead
Moelfre
Llanddwyn
Rhyl
Heysham
New Brighton
Morecambe
Fleetwood
Blackpool
Lytham St Annes
Barrow
Douglas
Peel
Ramsey
Port Erin
Port St Mary
Workington
St Bees
Silloth
Kirkcudbright
Kippford
Stranraer
Portpatrick
Girvan
Red Bay
Portrush
Arranmore
Bangor
Donaghadee
Portaferry
Newcastle
Kilkeel
IRELAND DIVISION
Clogher Head
Skerries
Howth
Dun Laoghaire
Wicklow
Arklow
Rosslare Harbour
Dunmore East
Kilmore
Tramore
Youghal
Ballycotton
Courtmacsherry Harbour
Baltimore
Valentia
Galway Bay
WEST DIVISION
SOUTH WEST DIVISION
SOUTH EAST DIVISION
Alderney
St Peter Port
St Catherine
St Helier

The Atlantic 21 class, a 21-foot (7 meter) twin-engined inflatable will be replaced by the Atlantic 75, which is capable of 34 knots.

uphold extremely high standards. We can't walk back on our commitment to these standards, which we are bound to maintain 24 hours a day all through the year.

"We have had difficult times for funding, particularly during the early 1970s, when we were down to a very low figure of reserves. A healthy reserve gives our supporters the confidence that we are planning in a positive way for the future. Certainly our reserves don't meet all our future commitments, but we are confident in our fundraisers, as we have always been. During the last century, from 1854 to 1869, the RNLI had to go to the government for assistance. . and there were problems; the government, quite rightly, wanted a say in how their money was spent. We were able to go it alone in 1869 and never have regretted it.

"There are 2,000 individual fund-raising branches, some of whose dedicated men and women have given 40-50 years of service. Perhaps the most thought-provoking aspect of our donations is that, of our income—which this year will probably near £60 million—about 60% will come from legacies."

Far from being a dusty anachronism dating to the days of sail, the RNLI provides a most modern service ... .

The RNLI recognizes the critical role the fundraisers play in floating each lifeboat mission; at each year's ceremony, presided over by the Duke of Kent, a number of awards go out to them as well—mostly for long, distinguished service. One such award last year went to a lady who began fundraising at her mother's persuasion when she turned 15, and who the week before the meeting celebrated her 93rd birthday. At this year's ceremony, citations for 30, 40 and even 60 years of service could be heard, each person proudly crossing the stage, receiving the award and a handshake room His Royal Highness as a true life-saver.

Some of these fundraisers collect money in inland cities hundreds of miles from the shore. Their efforts and faith are well rewarded by the RNLI's efficiency. Of every pound collected, 5% goes to administrative overhead (including salaries of full-time staff and of the single, full-time mechanic maintaining the boats at each station), 15% is reinvested in fundraising and 80% goes to the fleet.

This efficiency is a model for the way charities could be best managed. The RNLI is not the only such organization—another is the worldwide ambulance service run by the Knights of Malta—but through its success may be considered a valuable pointer towards an alternative to the coercive, statist methods employed by many governments to fund services and charities.

According to Commander Miles, who joined as an inspector of lifeboats in 1964 and became Director nearly 7 years ago, it seems that every few years the government 'takes a look' at the RNLI. "We've had our moments, especially with the Labour government, where they were 'reexamining the role of the RNLI.' One of the questions we're most often asked is 'Shouldn't the government be doing this?,' to which my answer is that the government have taken a very deliberate decision: They have committed themselves to providing a search and rescue organization, just like any maritime nation, and have given us the great responsibility of the lifeboat part of that. We in turn provide a highly sophisticated emergency service to very high standards 'round the clock at over 200 locations to meet this government commitment—voluntarily."

Far from being a dusty anachronism dating to the days of sail, the RNLI provides a most modern service that is more in demand than ever, and much-needed proof of the power and durability of private initiative and voluntary commitment.

Drifter News

Laurence Sombardier, Global Drifter Center
Scripps Institution of Oceanography

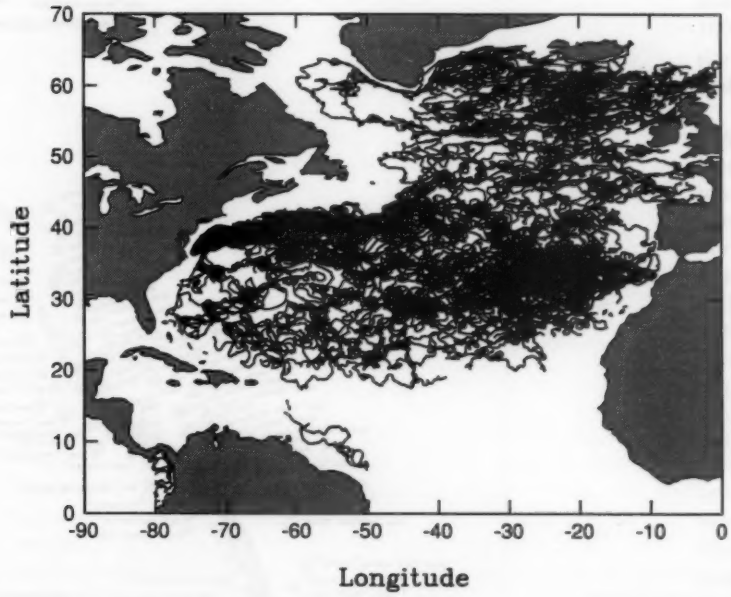
With the implementation of the Indian and Southern Oceans Surface Velocity Program (SVP) drifter arrays in 1994, commercial vessels are now involved in the launching of SVP drifters in all of the worlds oceans. The North Atlantic Drifter Program is the one that has relied the most heavily on the support provided by Voluntary Observing Ships (VOS). VOS ships have deployed 80% of that drifter array since its implementation in 1991. Vessels such as the ***Bibi, Cumulus, Infanta, Jokulfell, Mitla, Recife, Sea-land Achiever, Sealand Ile de France, Sealand Integrity, Sea Wolf, Skogafoss, St. Blaize*** and ***Strong Icelander*** have been instrumental in seeding the ocean with instruments and in maintaining the network necessary for the study of open ocean currents. The chart at top right shows the drifter trajectories for all the North Atlantic drifters deployed since 1991. The project is ongoing and in order to maintain the drifter array at acceptable levels for scientific study, 60 deployments per year are necessary. Most drifters are placed on ships out of Norfolk and Miami, and the two contact persons are Jim Farrington in Norfolk (Tel: 804-441-3062, FAX: 804-441-6495) and Warren Krug in Miami (Tel: 305-361-4433, FAX: 305-361-4582). Jim and Warren are also involved in the XBT/SEAS NOAA program.

We typically do not request that more than four drifters be deployed on a single voyage. The ***Skogafoss***, for example, has deployed six drifters in 1994 on two separate voyages (tracks are shown at lower right). Ships do not need to slow down for deployments and all deployments are done along the cruise track within a few degrees of the requested position. The drifters are easy to deploy and require minimal work as far as deployments go, but in return provide valuable information on the oceans surface currents.

Two new drifter arrays are currently being implemented: the Indian Ocean and Southern Oceans (from 30°S to 60°S). Although most of the Southern Oceans' deployments will be done by aircraft, VOS ships will be extensively involved in the Indian Ocean operations. Two vessels, the ***Nedlloyd Van Neck*** and the ***Nedlloyd Van Dieman***, have already been called upon and have made over eight successful deployments. We expect a variety of other vessels to be participating in this project. Vessels which already run the XBT lines in the Indian Ocean are most likely to be approached in the near future. Commercial vessels not involved with the XBT project have also been a tremendous help in the past and still are. The **American President Line Feeder Service** out of Singapore will be deploying drifters for SVP in the Bay of Bengal and the Arabian Sea.

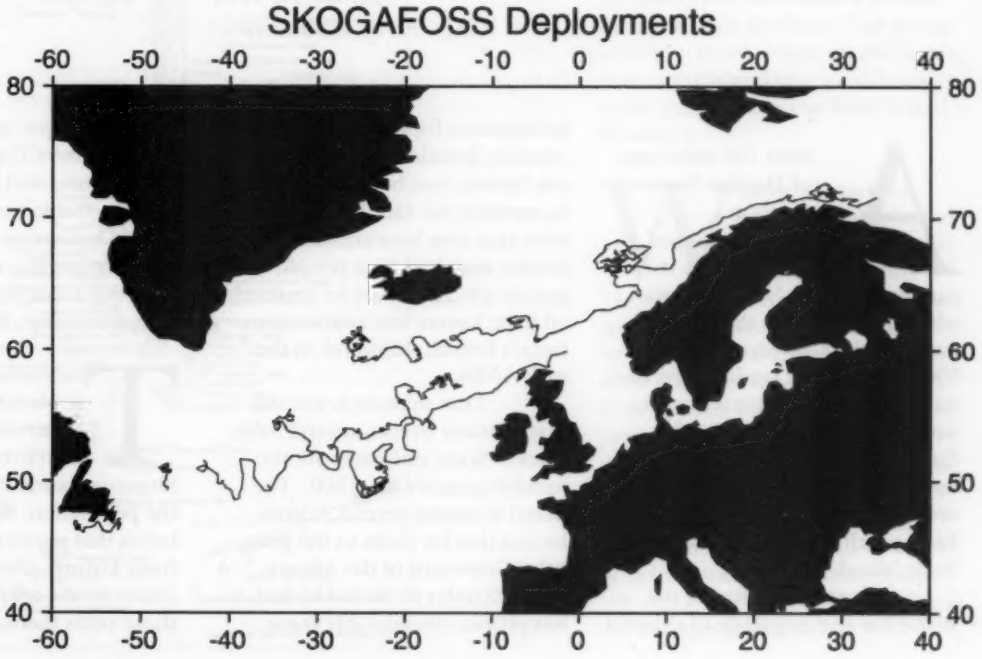
The Global Drifter Center is in the process of moving from Scripps Institution of Oceanography in La Jolla to AOML/NOAA in Miami. A new Manager, Mark Bushnell will be in charge of coordinating deployments starting in 1995. If you need drifter tracks, information on the drifter project or deployment positions, please contact Mark at 305-361-4353, FAX: 305-361-4582. His mail address is: Atlantic Oceanographic and Meteorological Laboratory, Physical Oceanography Division 4301 Rickenbacker Causeway, Miami, FL 33149.

BUOY TRAJECTORIES THROUGH JULY 31, 1994



Above is a chart of the trajectories of drifters deployed since 1991. While difficult to read, it gives a picture of just how extensive the program has become thanks to cooperating VOS vessels.

The ***Skogafoss*** *(below) deployed six drifters in 1994 on two separate voyages. Drifters are packaged for easy deployment off the stern of a vessel steaming anywhere between 2 and 30 knots.*



Sable Island's Lifesavers

Elinor De Wire
Gales Ferry, Connecticut

About 100 miles east of Halifax, Nova Scotia, a crescent–shaped island breaks the surface of the icy North Atlantic where it encounters the warm bands of the Gulf Stream. The Vikings may have landed here, and native tribes of maritime Canada surely knew about the island. Europeans did not encounter it until the Portuguese came upon it around 1500 and named it "Sandy Isle," which eventually became Sable Island.

Over the centuries, the island has seen a parade of colorful inhabitants–fishermen, fur traders, convicts, lunatics, pirates, oil seekers, heroes, and homesteaders, not to mention the rare Ispwich sparrows that nest here and herds of harbor seals and feral ponies. The ponies are thought to be descended from horses that swam ashore from a French shipwreck in the early 1500s.

That shipwreck was the first of many wrecks around Sable Island. Some estimates put the number at more than 500. The island is among several Atlantic locales that lay claim to the grim title "Graveyard of the Atlantic." A mere 22 miles from end to end, it has proven considerably more treacherous per mile than its shipwreck rivals of Cape Cod, the Outer Banks and the Florida Keys.

"Sable wears forever 'round her throat a necklace of men's bones like the grisly souvenirs of a cannibal," writes Sable Island historian, Bruce Armstrong.

The earliest settlers on Sable Island were French fishermen and fur traders who lived in crude huts. Shipwreck survivors also increased the population, and there is speculation that convicts were sent here from Europe. Nova Scotia sent the insane to the island because in those years there was no facility on

the mainland for them. New Englanders began arriving in the late 1600s, claiming plots of land alongside French Huguenots who had fled Europe.

In March 1738, Andrew LeMercier, a Calvinist minister from Boston and a Huguenot immigrant, began sending members of his flock to Sable Island to homestead and offer lifesaving and salvage services to the shipwrecked. Although his intentions were more self-serving than not, LeMercier's "Sea Hospital" was the first attempt to provide assistance to the continuous stream of castaways tossed onto Sable Island's shores.

Several tenuous lifesaving efforts followed, but it was Sir John Wentworth, lieutenant-governor of Nova Scotia, who launched the Sable Island Humane Establishment in 1801 with government backing. Wentworth hired James Morris to head the fledgling effort. Morris lived on Sable Island with his family and was assisted by four men and their families. This group formed a small colony on the north side of the island that would eventually gain fame as the Sable Island lifesavers.

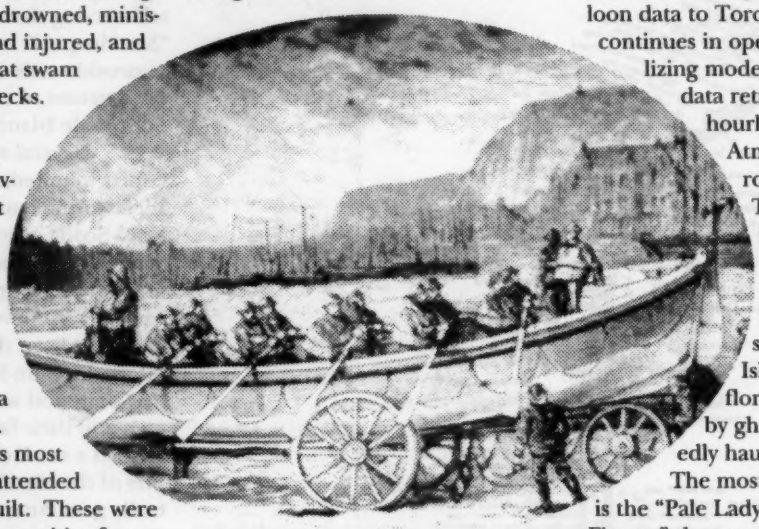
Wentworth tried to make the Sable Island colony as self-contained as possible. The islanders fished, hunted, grew stunted gardens in the sand and cultivated wild cranberries, raised livestock and rounded up the island ponies for mainland auctions. They had their own doctor and minister and held social events, but there was no school on the island until 1880 despite a large number of children. If food stores or spirits ran low, Wentworth sent out support, determined to make the colony successful.

Survival on Sable Island was difficult, but perhaps the colonists took inspiration from the work they did assisting the shipwrecked. The small lifesaving station was supervised by Morris, whose job was to drill his crew and coordinate rescues and salvage operations. Everyone pitched in, even the children, who were often put to work with their mothers digging graves for the drowned, ministering to the sick and injured, and trapping the rats that swam ashore from the wrecks.

Gradually, the lifesaving effort was expanded with the addition of smaller attended stations where a keeper was assigned to keep watch and signal if a wreck were sighted. Along Sable Island's most isolated shores, unattended refuge huts were built. These were outfitted with the necessities for survival—food, firewood and matches, dry clothes and blankets. They also contained instructions for obtaining fresh water (by digging in the sand) and directions to the nearest habitation.

The wreck of the fishing schooner ***Arno*** in 1846 caused a sensation in Europe and America when Sable Island's Humane Establishment superintendent, Captain Joseph Darby, reported a most unusual phenomena associated with the rescue. The ***Arno*** had been rendered unmaneuverable in a wild September gale and was headed for disaster on Sable Island's lee shore. In desperation the crew opened several casks of fish oil and threw it on the sea ahead of the ship. The Arno glided gently onto the beach, and its crew was rescued.

"I had often heard of oil smoothing the face of turbid waters," Darby wrote in his diary, "but I hardly believed it possible to subdue and smoothen so very rough and boisterous a surface!"



In the mid-1800s, flag signals and Costan lights (flares) were given to the Sable Island lifesavers. Also about this time, humanitarian Dorothea Dix visited and was so affected by the devotion and hardship of the lifesavers, she donated a large library of books to the island residents and arranged for the delivery of a line-throwing gun, breeches buoy and better lifeboats. Up until this time, all rescuing had been done in simple rowboats at great personal risk.

In 1880, lighthouses were built on the east and west ends of Sable Island and along with the improvements brought by steam navigation, reduced the number of wrecks. But lifesaving efforts continued, with major rescues taking place even after World War II.

Shortly after the turn of the century, the Canadian Department of Transport (now Ministry of Transport) set up a meteorological research station that relayed weather balloon data to Toronto. The station continues in operation today, utilizing modern methods of data retrieval to supply hourly reports to the Atmospheric Environment Service. The weather crew is kept company by oil drillers, who arrived in 1967, by scientists studying Sable Island's unique flora and fauna and by ghosts that supposedly haunt the island. The most famous of these is the "Pale Lady with the Missing Finger," the specter of a woman who drowned in the 1799 wreck of the ***Francis***. Storytellers say that after her body washed ashore from the wreck, a thief callously cut off her finger to get her valuable wedding ring. Her ghost has appeared countless times over the centuries, walking the beach in search of her missing, bejeweled finger.

Radio—Doctor Tesla and Doctor Preece

James V. Johnston
St. Petersburg, Florida

In reading your editorial in the Summer 1994 issue of *Mariners Weather Log*, there are two very misleading comments in regards to Guglielmo Marconi. First and foremost, Marconi did not invent radio. The actual inventor of radio was finally settled by the United State Supreme Court. (United States Cases Adjudged in the Supreme Court, Vol 320, pages 1–80, dated June 21, 1943.) The Supreme Court decision was based on printed course material Dr. Nikola Tesla used while teaching Electrical Engineering at Columbia University 1891–1893. Laboratory experiments at the University during this period of time led to the construction of the first true transmitter–receiver with an electronic Tube Detector (Geissler tube).

The first public demonstration of this equipment was at the National Electric Light Association Symposium in St. Louis in 1895 (NELA 1895 Symposium Journal, pages 92–94). Dr. Tesla filed a patent for a radio transmitting and receiving device with the U.S. Patent Office on September 2, 1897. His patent #645, 576, was granted on March 20, 1900. Marconi filed his first patent application on November 10, 1900 and it was rejected on the prior art disclosed by Sir Oliver Lodge. The entrance of several British experimenters into radio research can be traced to a visit by Dr. Tesla. During the spring break at Columbia University in 1892, Dr. Tesla agreed to lecture at the Royal Society in England. Using his course notes from Columbia, which were distributed to the attendees, he lectured on the transmission of radio waves. Two of the attendees, Sir Oliver Lodge and Dr. William H. Preece, began very aggressive development of the wireless equipment. Dr. Preece, who later became head of the British Postal Telegraph System, worked diligently at building a wireless system for trains. By 1895 he had developed a transmitter which was mounted in the mail car of express trains and was capable of transmitting Morse code to the telegraph wires running parallel to the tracks. Obviously, this was a rather short radio transmission path, but it worked very well.

By 1896 more than half the trains in England were equipped with wireless Morse code transmitters. This was the very first commercial use of radio for the general public. In fact, the British Railway System advertised that passengers could wire ahead to friends and relatives their expected arrival times. In essence, Dr. William Preece is credited with the title of "Father of Radio Telegraphy."

This letter is in no way intended to discredit or detract from the great accomplishments which Marconi gave the radio world. He was able to solve the major hurdle which had stumped all the rest of the early experimenters with his cascaded tuned circuits. But, unfortunately, it was media hype that jumped on his feat of transAtlantic transmission, and from this, a bigger than life image was created. It is truly sad to see that the analytical groundbreakers, who made the first small faltering steps do not get credit for their discoveries.

You are doing a fine job, and the articles in *MWL* are truly outstanding. By the way, I started my subscription with the Fall 1985 issue. Please keep them coming.

Cape Cod's Three Sisters

Elinor De Wire
Gales Ferry, Connecticut

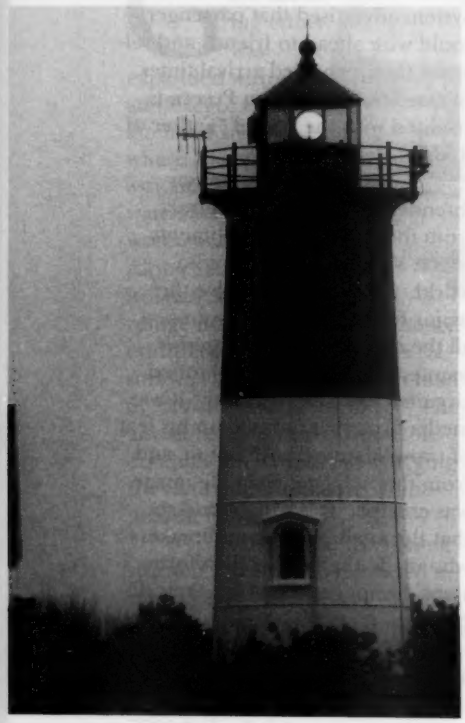
Cape Cod's steep cliffs at Nauset and Highlands overlook the sea from the center of the Cape's infamous backside beach, an eroded strand of bluffs and hollows and salt marshes that receives the brunt of Atlantic wind and has witnessed numberless maritime tragedies.

Near this beach the Nauset Indians came to the aid of the survivors of the ***Sparrow Hawk***, an English ship bound for the Virginia Colony in 1624 but forced ashore along the cape by scurvy and near-mutiny. Henry David Thoreau beachcombed here and spent a night with the lighthouse keeper at Truro. Years later, Henry Beston lived a hermit's life in a spartan beach house near Nauset and penned a tribute to the beauty of the sweeping seascape:

I see the lantern now as a star of light which waxes and wanes three mathematical times, now as a lovely pale flare of light behind the rounded summits of the dunes. The changes in the atmosphere change the colour of the beam ... .

Beston's "three mathematical times" describes well the first beacon at Nauset Beach. In 1838 the nation's only set of triple lighthouses was built here– three diminutive white towers capped with black lanterns. The little sentinels were intended to assist coastwise navigators hugging the backside of the cape, and they were quickly dubbed the "Three Sisters of Nauset," due to their resemblance to three dainty ladies in white dresses and black hats.

The government opted for triple lights at Nauset to distinguish these beacons from other lighthouses in the area. At Monomoy a single beacon guided shipping around the cape's southern extremity; at Chatham, near the elbow, there were twin lights; on the Highlands north of Nauset a landfall beacon stood, the brightest on the cape. The European system of flashing lenticular optics was not yet in use in the U.S. in the 1830s, so multiple lights provided the answer to the problem of identifying lighthouses in close proximity.



U.S. Coast Guard

In 1923, one of the twin lights at Chatham was also discontinued. Since it was tall and a sturdier, cast iron tower, Putnam decided to move it to Nauset Beach.

The three small Nauset lighthouses were constructed in only 38 days, each one of brick, 5 meters tall, with iron lanterns and granite stairways. They were situated 46 meters apart atop the 21-meter high bluffs at Nauset Beach. Their builder, Winslow Lewis, also constructed a keeper's house and dug a well, in addition to outfitting the towers with old-fashioned oil lamps and reflectors– all for a prudent price tag of $6,549. His work was severely criticized, for he had not built the towers in the exact positions surveyors had chosen, and they were built directly on the sand with inferior materials.

In 1858 the archaic oil lamps and reflectors of the Three Sisters were upstaged by sixth-order Fresnel lenses imported from France, which greatly improved the range and clarity of the lights. Ten years later, blowing sand had so badly frosted the lantern windows they had to be replaced. By this time, it was apparent that erosion was claiming

the bluff at a measurable rate and would eventually topple the little lighthouses.

Recognizing the threat, the Lighthouse Board in 1892 replaced the old brick sentinels with three 7-meter wooden towers situated farther inland. The original lantern caps and prism lenses were moved onto the new towers. Within a few years, the decapitated brick towers tumbled over the cliff and disappeared into the sea. Beachcombers still occasionally find pieces of their brickwork, smoothed by decades of tumbling in the surf, and an occasional low tide uncovers the old foundations.

In 1911, the penurious chief of the newly-formed Bureau of Lighthouses, George Putnam, decided the beach at Nauset was a prime example of "overlighting." An inspection revealed that erosion was again threatening the station and that the yearly consumption of 300 gallons of oil could be reduced to 100 gallons if two of the lighthouses were discontinued. In addition, sailors claimed the triple lights merged into a single or double light from certain positions at sea, causing confusion.

Putnam extinguished two of the Nauset triplets and ordered the third triplet moved next to the keeper's house where it was attached by a covered walkway. Its brilliance was increased with a fourth-order flashing lens, but the keeper complained that the little tower vibrated in the wind, causing the light to pulse. Guywires were installed to stabilize it and no further vibrations were reported. The two abandoned towers were decapitated and sold for $3.50 each to a local resident, who converted them into a summer cottage.

In 1923, one of the twin lights at Chatham was also discontinued. Since it was tall and a sturdier, cast iron tower, Putnam decided to move it to Nauset Beach and decommission the remaining "Sister." The new Nauset Light was painted lower half white and upper half red to distinguish it from Highland Light and its twin at Chatham. Though Putnam was noted for his solemnity, he gave the new Nauset Light a triple flash characteristic, in honor of the lost little trio that had served mariners for 85 years.

The last, headless little "Sister" was hauled away and underwent a facelift similar to its siblings.' It served first as a cottage, then a hamburger stand for the tourists who flocked to Nauset Beach in the summer. No one protested the irreverent fate of the Three Sisters. Hardly anyone was aware of their historic importance as the only triple light station ever built in the U.S. and one of few worldwide.

The refurbished one of Three Sisters, which were the only triple light station in the U.S. and one of the few in the world.

The Casquets off Cherbourg, France once had triple lighthouses, as did the dangerous Lizard in the Scilly Isles at the entrance to the English Channel, but neither set of triple towers stands intact today. Time and tide have reduced the Casquets to stumps and obliterated the Lizard's trio.

In the 1960s, when the National Park Service established Cape Cod National Seashore, interest in preserving cape heritage burgeoned, and the uniqueness of the Three Sisters was realized. Fortunately, it was not too late to save them. One by one the hapless, little towers were purchased by the park service and placed in storage until funding became available to refurbish them.

In the late 1980s the towers were repaired. Only one had its lantern intact, and not enough money was appropriated to fabricate new lanterns for the other two or beacons. Rather than wait for additional funding, the National Park Service went ahead with restorations, for the Sisters were badly deteriorated. Perhaps at some future time money will become available to reinstate the lanterns and optics.

The Three Sisters of Nauset now sit in a wooded park a safe distance back from the beach, to assure that erosion doesn't claim them again. Though they no longer function as active navigational aids, they shed great light on the seafaring history of 19th century New England and stand as small monuments to Yankee ingenuity.

Central American CoastWatch?

Pablo Clemente–Colón and Paul Chang
NOAA/NESDIS Satellite Research Laboratory

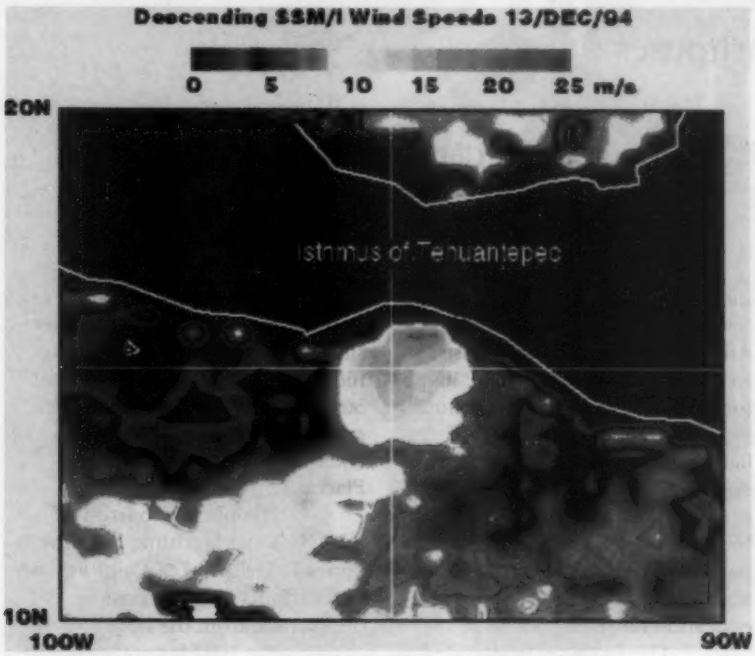
An AVHRR satellite acquisition station is now operational in Costa Rica. It is managed by the Oceanography and Coastal Management Laboratory (LAOCOS) of the Universidad Nacional de Costa Rica (UNA). The station, manufactured by the SeaSpace Corporation of San Diego, California, was installed north of the Costa Rican capital of San Jose at 10°N, 84°W and 1,158 meters above sea level. The location of the station allows the acquisition of high resolution satellite data over the Caribbean and a large part of the Eastern Tropical Pacific. LAOCOS is planning to process and distribute satellite imagery internationally in near-real time.

Under the direction of Guillermo Quiros, a physical oceanographer, LAOCOS will be using satellite imagery to conduct ocean research on the generation and propagation of eddies in the Eastern Tropical Pacific, the development of regional upwelling and on local pelagic fisheries, among other topics. An important part of the research will include the correlation of satellite observations with shipboard measurements of sea surface temperature (SST), salinity, and ocean color. This work will provide increased knowledge of the effects of the region's ocean current systems and upwelling phenomena on fishing activities and species dynamics.

The NOAA-12 AVHRR high resolution satellite data presented in the lower right were captured and processed to SST's by the Costa Rican station and provided to the NOAA Satellite Research Laboratory via internet. The SST image shows temperatures over the Gulf of Tehuantepec in southern Mexico on December 14, 1994. The image uses a grey scale from 22°C to 30°C with land and clouds appearing as black. The presence of upwelled waters is clearly seen as a cool feature extending southward from the coast of Tehuantepec. This upwelling is driven by an intense wind jet blowing southward from the Gulf of Mexico through a mountain gap in the Isthmus of Tehuantepec. The upwelling feature extends to about 13°N where part of it turns clockwise delineating an anticyclonic warm eddy of around 100 kilometers in radius that was probably spun off by the wind driven circulation. The occurrence of intense localized winds over the Gulf of Tehuantepec is confirmed by the previous day's DMSP SSM/I satellite wind speed image presented in upper right. This image shows wind speeds using a grey scale from 0 to 25 meters per second. The white to grey region in the center of the image and extending down to the left represents speeds greater than 10 meters per second (19 knots) with a maximum wind speed of approximately 17 meters per second (33 knots) close to the coast. In fact, localized winds greater than 20 meters per second (39 knots) are not unusual in the Gulf of Tehuantepec.

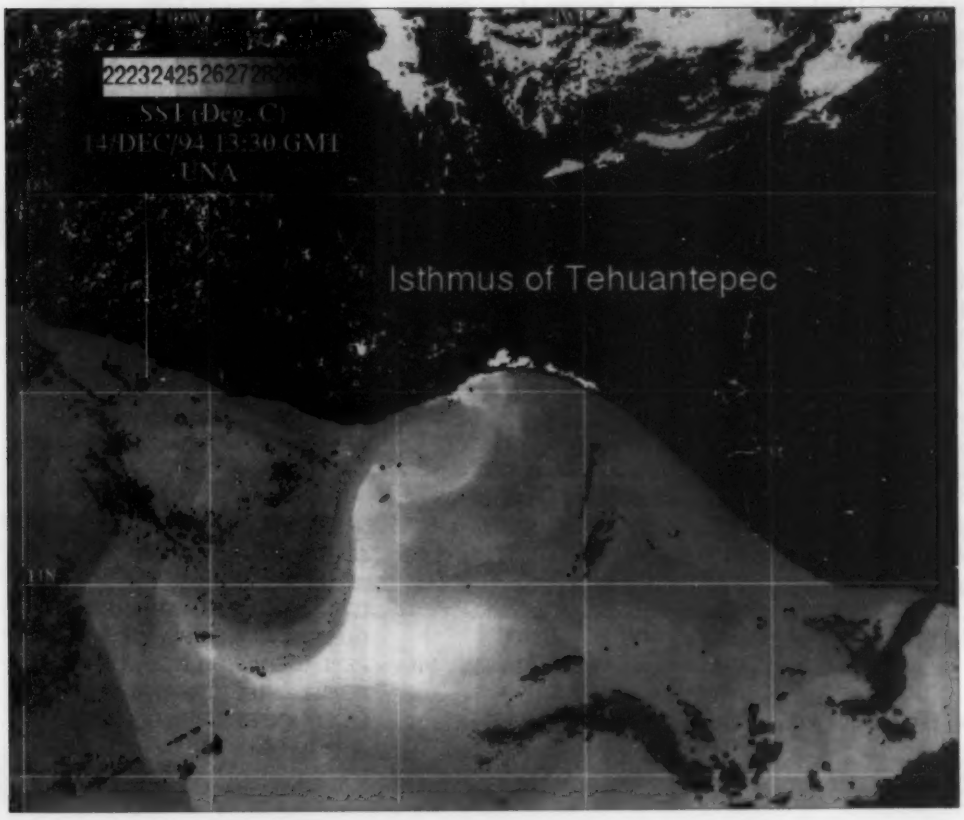
For more information on LAOCOS programs, you may contact Guillermo Quiros through any of the following:

e-mail: gquiros@irazu.una.ac.cr
e-mail: cequiros@cariari.ucr.ac.cr
Telephone: (506) 277-3347
Fax: (506) 260-1197



Below, the NOAA-12 AVHRR high resolution satellite data after being processed to Sea Surface temperatures (SST's) on December 14, 1994 over the Gulf of Tehuantepec. At left, the previous day's DMSP SSM/I satellite wind speed image shows the occurrence of intense localized winds in the Gulf.

The wind is known to mariners as the Tehuantepecer–a local wind caused by intense continental highs that move southward from the U.S. over the Gulf of Mexico. The air flows into the narrow Tehuantepec Pass and rushes violently down to the Gulf of Tehuantepec frequently spreading out over the entire area and can be felt out to 100 miles at sea. Although there may be a preliminary squall, skies are most often cloudless. Wind direction is northeast through northwest and the duration of the gale depends upon the extent, strength and permanence of the controlling high; gales may last for a few hours or continue for several days. Salina Cruz, at the head of the Gulf, averages about 20 days per month with gale force winds from November through January.



Inventory of U.S. Lighthouses

Candace Clifford
National Park Service

No other national lighthouse system in the world compares with the United States in size as well as diversity of architectural and engineering types. Technological changes in the 20th century ultimately doomed the manned lighthouse stations and today, all stations but one, the Boston Harbor Light, are automated.

Recognizing the historic value of these maritime resources, the National Maritime Initiative, a program within the National Park Service, surveyed and evaluated stations around the country for the *1994 Inventory of Historic Light Stations*, the most comprehensive survey of American lighthouses ever published. The inventory contains the location and description of 631 towers at 611 stations on the Atlantic, Pacific and Gulf coasts, as well as the Great Lakes. The inventory also includes 360 illustrations.

The popular appeal of lighthouses has created a tremendous body of support for their preservation. Private groups have been permitted to open museums, parks and recreation areas and create popular tourist attractions and education facilities.

The *Inventory* is intended to support lighthouse preservation organizations by providing a means for coordinating their activities.

Based on a computerized lighthouse database created in 1988, the inventory tracks location, physical characteristics of historic towers, keepers quarters, and if applicable, fog signal building, original and current optic, ownership, current use and historic significance. All stations are at least 50 years old and most have been evaluated for inclusion in the National Register of Historic Places.

The photo (courtesy of NPS National Maritime Initiative/ James P. Delgado) of Point Fermin Light (right) and description (below) are from the book.

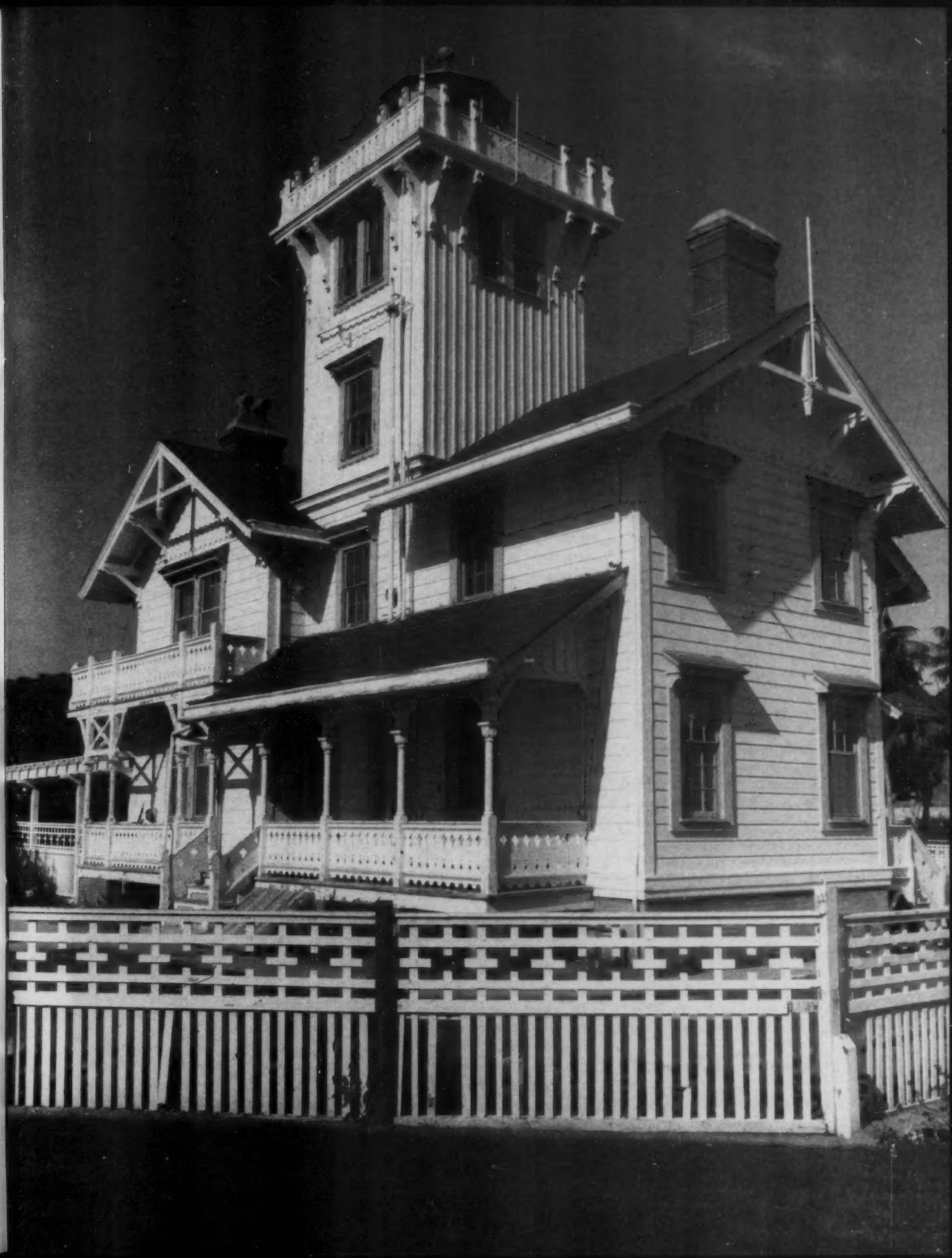
The 1994 Inventory *is 430 pages, perfect bound, and includes 360 illustrations, a bibliography, 2 appendices and an index. It is available from GPO by sending $25 to Superintendent of Documents, Washington, D.C. 20402. Indicate stock #024-005-011139-1. Price includes handling and postage.*

POINT FERMIN LIGHT

Location: POINT FERMIN/SAN PEDRO HARBOR U.S.C.G. District 11
Nearest City: SAN PEDRO
County: LOS ANGELES
Year Station Established: 1874
Year Existing Historic Tower Constructed: 1874
Is the Light Operational? NO
Deactivated: 1942
Foundation Materials: BRICK
Construction Materials: WOOD FRAME
Markings/Patterns: ITALIANATE TOWER ON ITALIANATE DWELLING
Shape: SQUARE
Relationship to Other Structures: INTEGRAL
Tower Height: 30; Height of Focal Plane: 100
Original Optic: FOURTH ORDER, FRESNEL (1874)
Present Optic: REMOVED
Is there a Newer Tower? YES
Year Constructed: 1926
Shape: POLE
Height of Focal Plane: 120
Is there an Existing Fog Signal Building? NO
Is there an Existing Keepers Quarters? YES
Year Constructed: 1874; Number of Stories: 2
Architectural Style: ITALIANATE VICTORIAN
Construction Materials: WOOD FRAME
Other Structures: CISTERN, OIL HOUSE, BARN
Owner/Manager: CITY OF LOS ANGELES/POINT FERMIN LIGHTHOUSE COMMITTEE
Current Use: CITY PARK
Open to Public? YES; GROUNDS ONLY
Access: POINT FERMIN PARK/WEST OF PACIFIC AVENUE

National Register Status: LISTED: POINT FERMIN LIGHTHOUSE

ITALIANATE LANTERN REMOVED DURING WORLD WAR II, REPLACED WITH LOOKOUT ROOM AND LATER METAL LANTERN; RESTORED BY SONS AND DAUGHTERS OF THE GOLDEN WEST.



Regional Products

Lee Chesneau
Marine Forecast Branch, National Weather Service

Regional surface graphic products target both near shore and high-seas users. These products are produced on polar stereographic map backgrounds encompassing the western Atlantic Ocean west of 50°W and north of 30°N including the U.S. East Coast and the central Florida coast. Also covered is the eastern North Pacific Ocean, from the Baja Peninsula, south to Cabo San Lucas, and north to the Gulf of Alaska, including Prince William Sound as far west as 150°W. The regional products at present consist of the 24-Hour Surface Forecasts and Wind/Wave Forecasts. These products depict synoptic and mesoscale forecasts of pressure systems, isobars, frontal features, areas of reduced visibility, wind speeds and significant wave heights within 800–1000 miles of the U.S. East and West Coasts. The Marine Forecast Branch at the National Meteorological Center, Washington D.C. currently issues the forecast products twice daily per ocean.

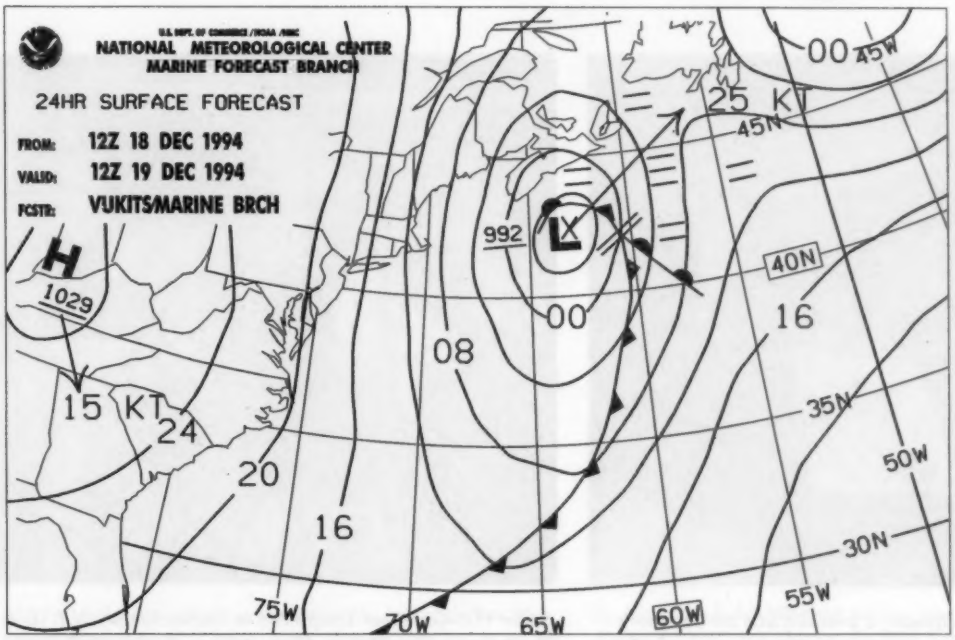
24 Hour Surface Forecast....

This surface forecast chart features low and high pressure center positions with bold 3 and 4 digit central pressure values underlined under or adjacent to the "L" or "H". A vector arrow depicts direction of movement and a numerical value of speed in knots is located adjacent to the head of the vector arrow. Also displayed are frontal systems (occluded, warm, and cold) and, when appropriate, associated areas of fog, signifying areas of potential restriction to visibility. Frontal systems also imply regions of visibility-reducing precipitation. Isobars or lines of equal surface pressure are drawn in increments of 4 millibars (MB) except 8 MB for deep systems (i.e., 960 MB). The 1000–MB contour will be dashed to separate 4 MB from 8 MB contour spacing.

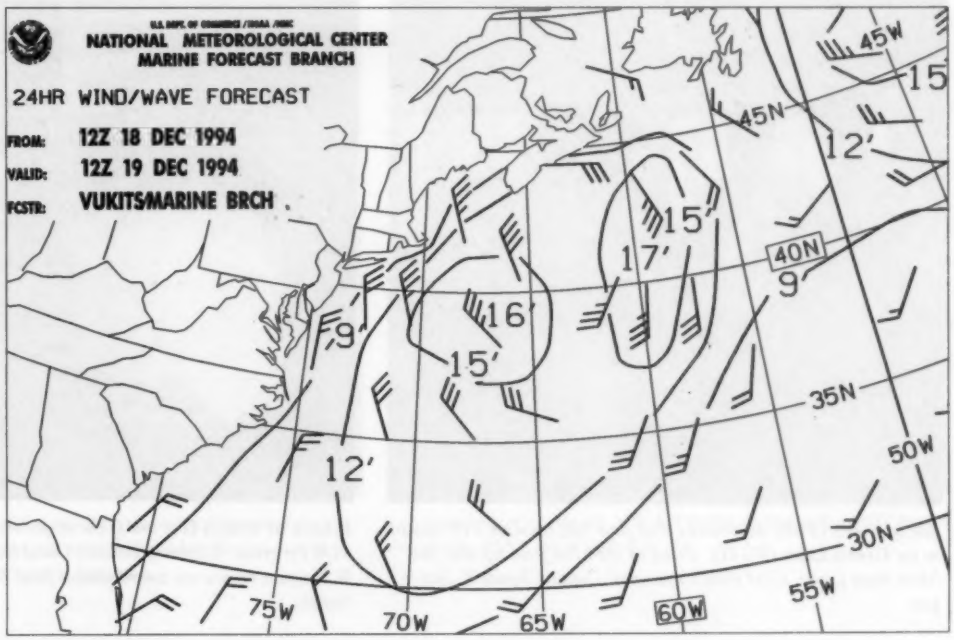
24-Hour Wind/Wave Forecasts....

This forecast product depicts 24–hour forecasts of wind (barbs in increments of 5 knots) and significant wave heights (isopleths of combined sea and swell in 3–foot intervals). The wave height values are depicted by solid contours. During appropriate weather conditions (such as "North Wall" episodes occurring along the northern wall of the Gulf Stream in the western Atlantic), substantially higher wind/wave height values are highlighted to the side of the chart over land. Vector arrows point to a superimposed hatched area of the Gulf Stream. The "North Wall" event is normally confined to the adjacent areas of the northern edge of the Gulf Stream. Forecast guidance to prepare this product is provided by wave height models from the U.S. Navy and NOAA, including data input from Special Sensor Microwave Imagery (SSM/I) of satellite derived wind speeds over ocean areas. This high state of the art technology of data input represents a significant step in analyzing wind conditions over the marine environment. This is especially noteworthy in data sparse areas (where there are no ship or buoy reports). SSM/I can aid in short range prediction of the 24–hour forecast products by enabling marine meteorologists to compare initial data from forecast model output and make the necessary adjustments to the near term forecast solutions.

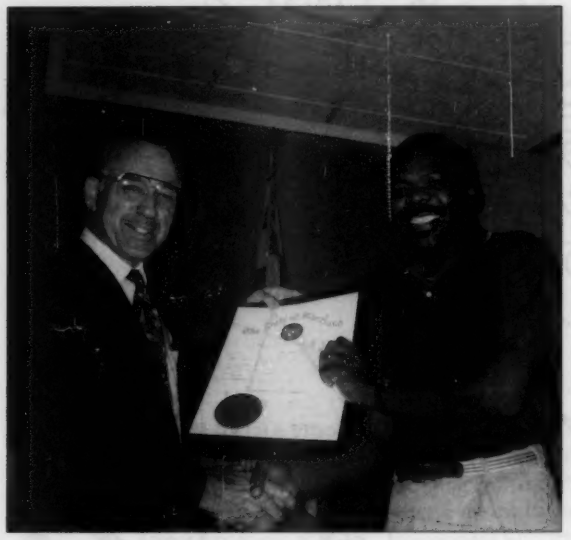
Plans to add two additional 36–hour Surface and Wind/Wave Forecasts for the western Atlantic are under consideration.



On the surface forecast chart above, high and low pressure center positions are shown with bold 3 and 4 digit central pressure values underlined under or adjacent to the "H" or "L." A vector arrow depicts direction of movement and a numerical value of speed in knots is located adjacent to the head of the vector arrow. On the Wind/Wave forecast chart below, wind speed is indicated by the barbs in increments of 5 knots and isopleths of combined sea and swell are shown by solid contours in 3-foot (1 meter) intervals. Both charts are issued twice daily and are available for the U.S. West Coast as well.



Awards for Excellence

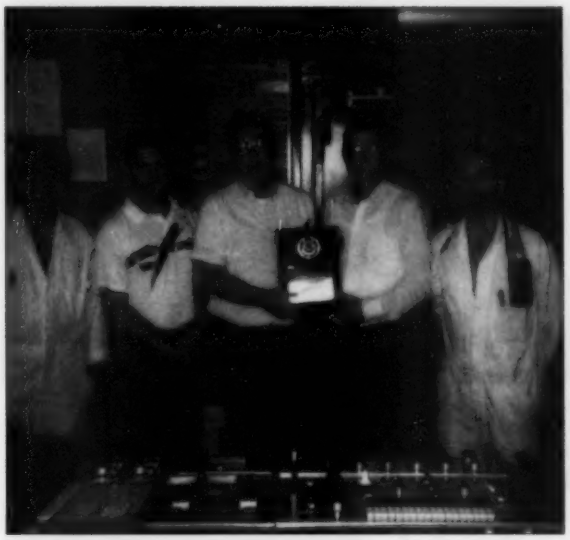


Jim Saunders (PMO Baltimore) is presented with the Governor's Citation for outstanding service to the marine community during his past 4 years in Baltimore. Awarding the citation to Jim is Theodore E. Mathison, Administrator for the Maryland Department of Transportation.

Junior VOS–Girl Scout Troop #261 in Duchess County, N.Y. (L–r) Troop Leader Mary Dawon, Alison LeFever, Makeda McWilliams, Marie Miller, Edith Dawson and Olivia Cangelosi, Asst. Leader. Front row: Stephanie Cangelosoi, Katie Cardarelli, Jenny Cangelosi, and Stephanie Hemroth. Amber Abiolo also took part in a weather recording project. Future PMOs maybe?

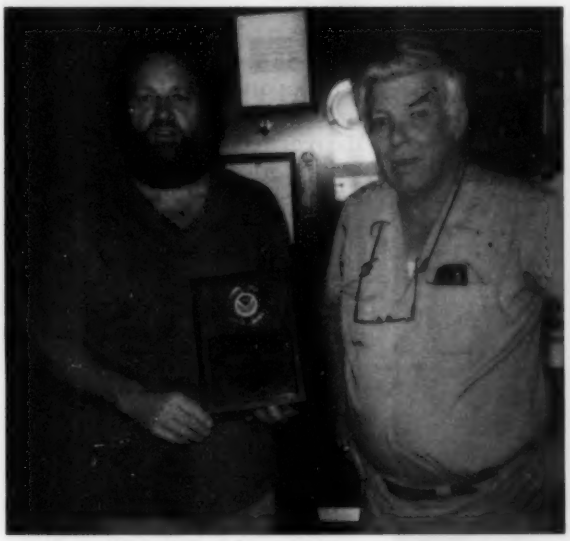
Jim Saunders (PMO Baltimore), 2nd from left, presents VOS award to the **Green Lake** *(KGTI). Pictured with Jim from left are: 3rd Mate Matt Lyons, C/M Paul Camirand, Captain James K. Staples.*

Prince of Tokyo II *is one of the ships recognized in 1993 by the VOS Program. Captain Oriando Casul (on left) and CO Restituto B. Singson receive an award plaque from Dave Bakeman, PMO Seattle.*



PMO Norfolk Marty Bonk, surrounded by the crew of the **Sea Merchant**, *presents the 1993 VOS award. Standing left to right are Mr Vernano, C/O Peters, Bon, Captain Reimers, and Mr. Flannagan.*

Lt. Kitt, NOAA ship **Whiting**, *receives congratulations and a plaque for 1992 ship observations from Norfolk PMO Marty Bonk.*



Second Mate Clark Swarthout and Captain Cecil Lamb of the **Sea-land Hawaii** *receive the outstanding observations award plaque from Seattle PMO Dave Bakeman.*

A. Karl Jaskierny, Master of **S/L Pacific** *is awarded a VOS Award by Seattle PMO, Dave Bakeman.*

Around the World in 32 Days for the VOS/SEAS Drifting Buoy Program

Steve Cook
SEAS Operations Manager

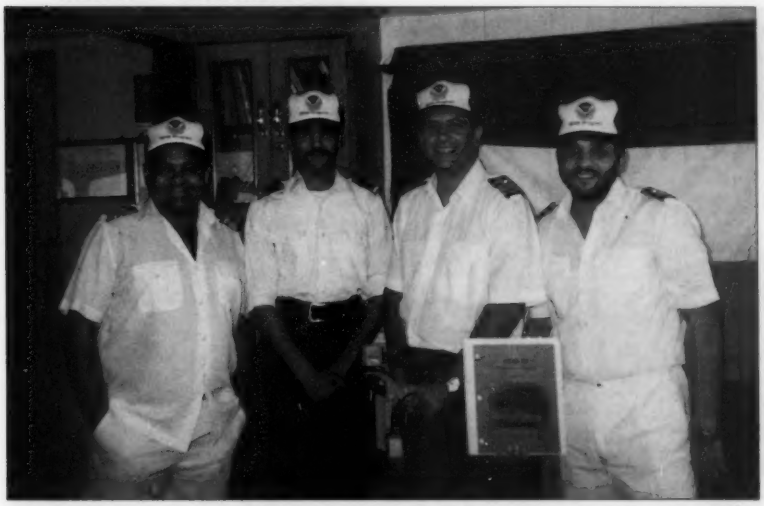
The National Ocean Service Observations Network Branch has been working with the scientific community this past year to implement a more comprehensive Voluntary Observing Ship network in the Indian Ocean. The goal was to have in place by the beginning of 1995, a network of SEAS supported vessels that would collect meteorological and expendable bathythermograph (XBT) observations and deploy drifting buoys.

The SEAS Program has been collecting data for many years in the Indian Ocean from ships that call in the United States and more recently with ships that call in South America. However, in order to operate an expanded XBT program, SEAS would have to be establish support on the borders of the Indian Ocean because several of the required transects could only be supported by vessels that never operate outside of the Indian Ocean.

Mr. Tan Suan Foon, Deputy Director of the Singapore Meteorological Service.

Beginning in May 1994 communication lines were strengthened with the Singapore Meteorological Service, South African Weather Bureau, the Kuwait Oil Tanker Company and American President Lines, as well as the Mauritius Meteorological Service and the National Institute of Oceanography of Pakistan. To cement this increased communication, it was necessary to visit the area.

On September 16, 1994, I departed San Diego for Singapore for meetings with the Singapore



Below is Mr. Edmund Lee, PMO Singapore Meteorological Service. Above, left to right are Capt. M. M. Vashist, 3rd Officer Asad Al Mane, 1st Officer Bassam Daha and 2nd Officer Tarek Saleh Mohamed of the KOTC VLCC m/v ***Al Shuhadaa****. Below, right are Capt. Z. A. Rizwani and the Bridge Officers of the VLCC m/v* ***Al Awdah****.*

Meteorological Service and American President Lines. The purpose was to locate storage space for XBT's and Drifting Buoys and to increase the SEAS Program awareness among those who will be supporting SEAS in the future.

I worked closely with Edmund Lee, PMO of Singapore Meteorological Service, and trained him in the implementation of the latest version of the SEAS software. I also provided SEAS operation and training manuals, Drifting Buoy instructions and a summary package of handouts and view graphs. Also, while in Singapore I met with American President Lines (APL) personnel Mr. Jacop Goe (Director, Feeder Divsion), Capt. Tony Kwok (Marine Manager for Chartered Vessels), and Mr. Gordon Leung (Marine Superintendent). APL operates a "feeder" service across the Indian Ocean from the Arabian Gulf and Bay of Bengal to Singapore.

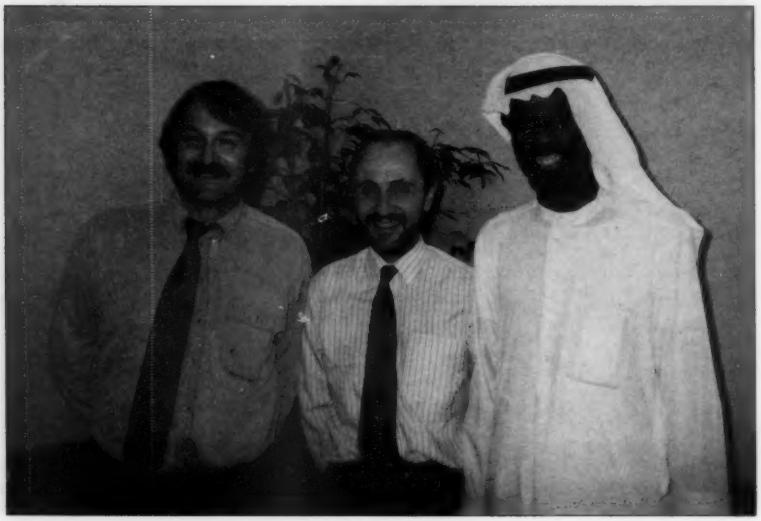
APL has generously agreed to assist NOAA in supporting our Drifting Buoy effort in the upper Bay of Bengal and Arabian Sea by managing the storage and deployment of Drifting Buoys.

I then traveled on to the United Arab Emirates and the small port city of Khor Fakkan and boarded the Kuwait Oil Tanker Company (KOTC) tanker m/v ***Al Shuhadaa***. While en route to Kuwait City, with the assistance of the ships officers, we installed and tested a SEAS unit and trained the bridge officers in its operation. This was the second of three installations on KOTC vessels. The first was the m/v ***Al Awdah*** and the last was on the m/v ***Al Samidoon***. All KOTC vessels participate in the Great Britain Meteorological Service VOS Program and therefore the officers are well trained and motivated in the collection of meteorological and XBT observations. In Kuwait City I met with Captain Al Turki (General Superintendent Fleet Operations Group), Captain Norman Ford (General Superinten-

Above are Capt. R. M. Linley-Munro and the Bridge Officers of the KOTC VLCC m/v Al Samidoon. Below are left to right: Capt. Norman Ford, Capt. Richard Gibas and Capt. T. M. Al Turki, all of the KOTC Fleet Operations. Below, right are Mr. J. A. "Lappies" Labuschagne, Deputy Director of Technical Services of the South African Weather Bureau (left) and the author Steve Cook (distinguished-looking older gentleman).

dent Met. Operations) and Captain Richard Gibas (Marine Superintendent Crude Fleet-Fleet Operations Group) of the KOTC to discuss procedures as to how to best support the vessels. The KOTC operates several tanker routes from the Arabian Sea to the Far East as well as Mauritius. Accordingly, KOTC has graciously offered to act as a center point for SEAS support in the Gulf area.

I then traveled on to Pretoria, South Africa and met with Mr. "Lappies" Labuschagne (Deputy Director of Technical Services). Discussions centered on South Africa's role in the VOS and Drifting Buoy Program as well as the implementation of SEAS support in Durban and Cape Town. Cape Town is already a staging point for the Drifting Buoy Program and Durban will be the main depot for XBT's and SEAS support for the Indian Ocean. Training and summary package's were provided as in Singapore. Moving on to Durban, I worked with the meteorologists and the PMO (Mr. Fergus McKay) to setup, test, and demonstrate the operation of two SEAS units. Two ships have been identified that cover the transect from Durban to Bombay. Meetings were held with Unicorn and Afris Shipping Lines to work out lines of communications to the Weather Bureau and PMO. As well as the two Durban/Bombay vessels that Mr. Fergus McKay (PMO) will personally support, he will also visit and, if necessary, service every SEAS equipped vessel that calls in Dur-

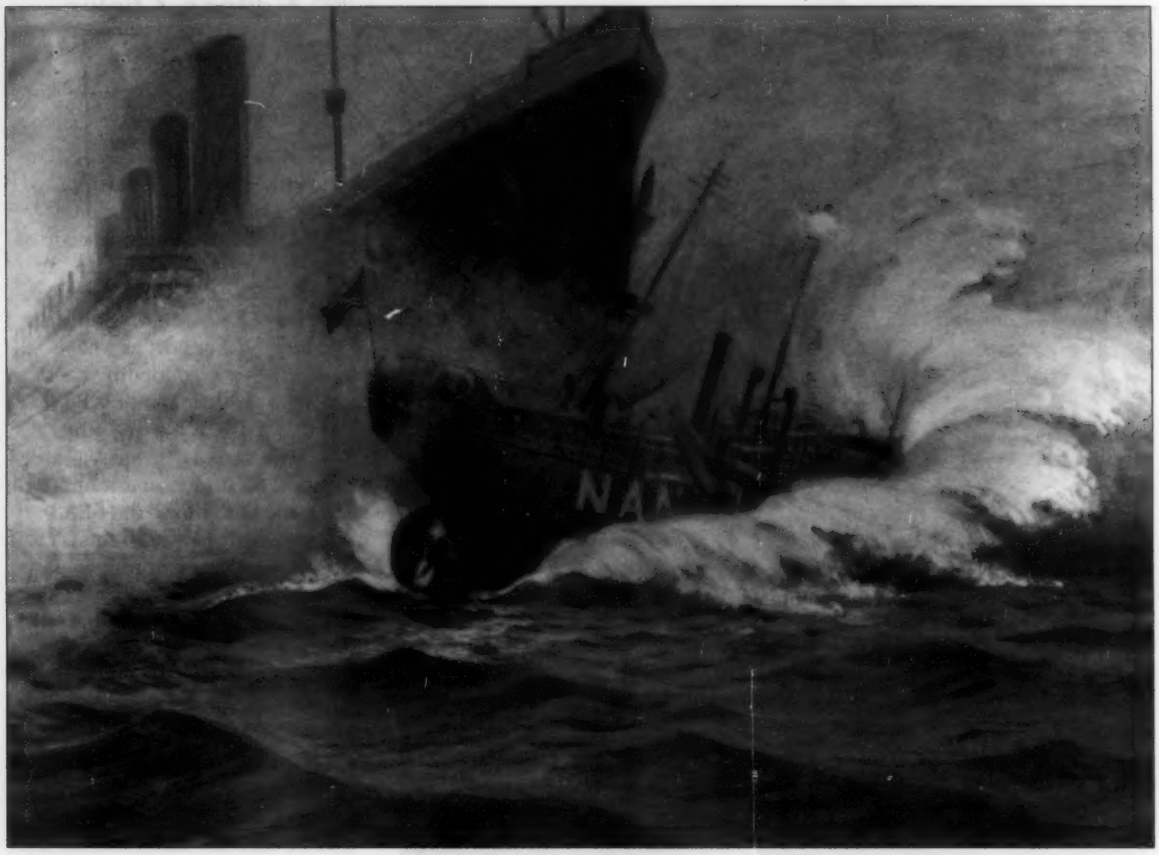


Above are Mrs. and Mr. Fergus McKay, PMO trainee and PMO of the South African Weather Bureau. At left is Capt. Gordon V. Mackie, Marine Superintendent Branch Director of England's Meteorological Office along with Mr. Steve Cook (right), SEAS Operations Manager.

ban.

I then flew to London to meet with Lt. CDR. Richard Ball of the Royal Navy Hydrographic Office and Capt. Gordon Mackie of the U.K. Met. Office. I briefed Lt. CDR. Ball on the SEAS effort in the Indian Ocean, discussed future XBT and ship support as well as increased efforts to identify back up vessels for the Atlantic XBT Program. Discussions with the U.K. Met Office established a line of communication to assist in monitoring the data flow from SEAS units via Darmstadt onto the GTS. This will be important for monitoring those vessels that utilize SEAS units in the Indian Ocean that will never come under either the U.S. GOES East or West satellites. The U.K. Met Office also provided shipping information and a contact concerning some vessel traffic that operates between South Africa and South America.

The success of this extensive and complicated trip was due to the contribution of many people with one thing in common. They all had a "can do" attitude, and maybe more importantly, a sense of humor. They are as follows: The NOS/ONB Headquarters staff, the Foreign Travel/Visa Office, the MFS/SWF&RC support staff, Balboa Travel and American Express. We also commend the perseverance and patience of Kathy Cook and sons, Jet and Colin, who didn't change the locks on the house while I was gone.



LIGHTSHIPS
SENTINELS OF THE SEA-LANES
PART 2

WILLARD FLINT
U.S. COAST GUARD

The Bureau of Lighthouses was established within the Department of Commerce in 1910. Under the able and progressive leadership of Commissioner George Putnam, the Bureau moved rapidly to the forefront of the world's agencies engaged in developing and maintaining Aids to Navigation. He emphasized competence and demanded professional performance by all employees, and he was responsible for remedying the long-standing problems with pay, living conditions, benefits and a safe and efficient work environment.

The organization prospered for nearly 30 years, perfecting the use of beacons, modernizing illuminants and optical equipment, improving signalling methods, advancing the use of automated aids, and

This article originally appeared in the U.S. Coast Guard's *Commandant's Bulletin*, May 1993 in its entirety. All photographs courtesy of the U.S. Coast Guard Historian's Office.

demonstrating the feasibility of unattended and radio-controlled light vessels and lighthouses. The lightship itself was developed into an effective vessel specifically built to handle its environmental requirements with propulsion and auxiliary systems adequate to its needs. Watertight integrity and a variety of other safety features were also highly developed in lightships of the late 1930s.

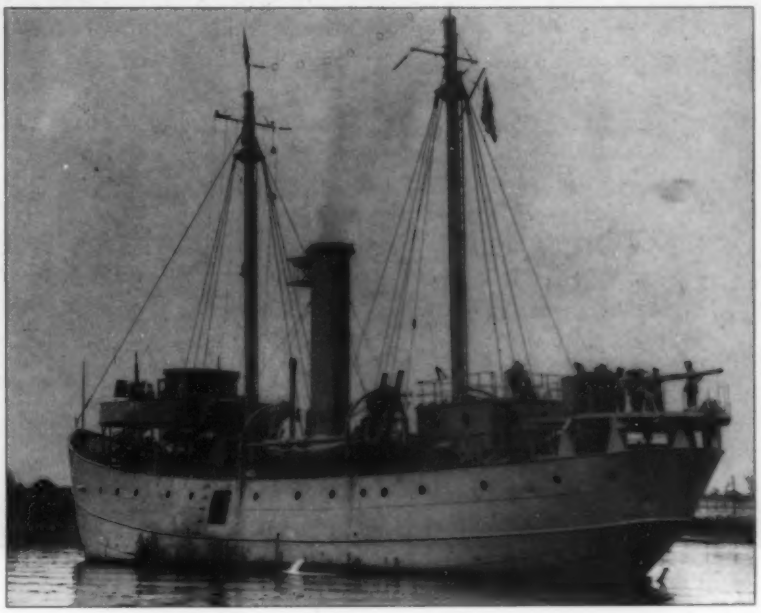
The liner, sistership to the ***Titanic***, suddenly materialized out of the fog, its towering bow hung poised like the blade of a guillotine ...

Despite safety improvements, these vessels were often at the mercy of weather, human error and sometimes a combination of the two.

On May 15, 1934, the ***Nantucket Lightship #117*** was riding at anchor in 58 meters of water off Nantucket Shoals. Its horn boomed into the fog to warn away the trans-Atlantic shipping that passed nearby. Unseen by sailors aboard the ***Nantucket*** was the 47,000-ton British luxury liner RMS ***Olympic***. Steering to the lightship's radio beacon signal, the ocean liner intended to alter course at the last moment and pass close by the ***Nantucket***. On the bridge of the ***Olympic***, someone miscalculated though. The liner, sister ship to the ***Titanic***, suddenly materialized out of the fog; its towering bow hung poised like the blade of a guillotine, then severed the lightship in two. Seven of the ***Nantucket***'s 11-man crew died in the collision. In response to the tragedy, the British government replaced the ***Nantucket*** with a new lightship, one resembling a miniature battleship. Its hull was fashioned from armor plate, enclosing a maze of 43 watertight compartments. Atop its mast was a light visible from almost 50 miles. And, whenever the foghorn would sound, a radio transmitter would automatically broadcast a signal, enabling navigators of oncoming ships to calculate the distance to the lightship.

Cross Rip Lightship #6 left no survivors or messages when it vanished off Massachusetts with all hands February 5, 1918. Observers on shore reported seeing the helpless lightship torn loose from its moorings by a huge mass of windblown ice and carried away. The aged wooden vessel had no masts, sails or other means of motive power and, not being equipped with a radio, its fate and that of its six-man crew remained a mystery for 15 years. No trace of the ship was found until 1933, when a government dredge working in the Vineyard Sound area sucked up splintered pieces of oak planking and ribs, and a section of a windlass believed to be from the long-lost vessel. The most likely explanation for its loss is that the ice crushed its hull, and the crewmen perished in the winter sea.

Another mystery surrounds the loss of ***Vineyard Sound Lightship #73***, which foundered during a 1944 hurricane with the loss of all hands. Its storm-battered wreck was explored by divers a few weeks after it sank, and again 20 years later, yet the actual cause of its loss remains unknown. Residents of Westport, Massachusetts, reported seeing a series of red and white flares streaking across the cloud-filled skies in the general direction of the lightship. After the

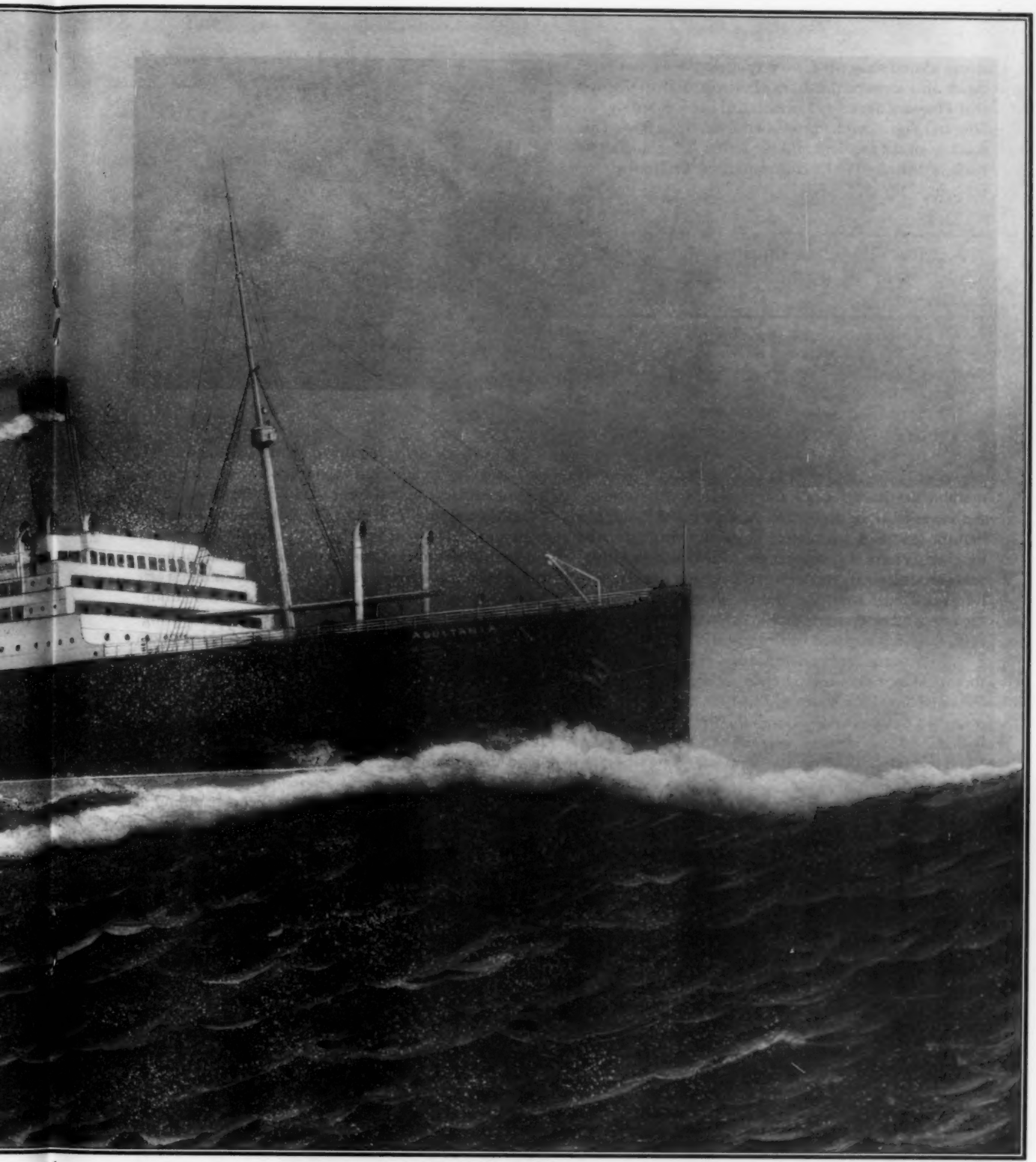


*At left, the **Nantucket Lightship #117** was sunk the morning of May 15, 1934, when it was struck broadside by the RMS **Olympic**. The 40.5-meter vessel sank within minutes with the loss of seven of its eleven crewmen. Just months before the **Nantucket** had a narrow escape when it was sideswiped by the ocean lienr USS. **Washington**. Painting used with permission of the U.S. Coast Guard.*

Vineyard Sound Lightship #73 *(right) shows its World War II fore and aft mounted guns. The vessel survived wartime threats but was lost with all hands in the famous September Hurricane of 1944. It went down off Sow and Pigs Reef, Massachusetts on September 18th.*

*The painting (centerfold) by Antonio Jacobsen of the **Aquitania** passing the **Nantucket Lightship** shows the inherent danger of using a lightship as a beacon. This lovely and very rare snow scene is from the Collection of Stephen L. Gaillard and was painted in 1914. The Mariners Museum provided us with the photograph.*

Aquita



quitania

storm abated somewhat, they struggled down to the beach and scanned the murky horizon, only to discover that ***Vineyard Sound #73***, which had been guarding Sow and Pigs Reef, had vanished from its station. This account of the incident and the rather intriguing aftermath is dedicated to its crew who remained at their posts until the end.

"The wind came shrieking and snarling out of the south," its skipper recalled, "blowing a hurricane."

In December 1936, a 90-knot gale assailed the ***Swiftsure Lightship #113***, anchored in the Strait of Juan de Fuca off the Washington coast.

"The wind came shrieking and snarling out of the south," its skipper recalled, "blowing a hurricane." The sea, he declared, "writhed and steamed like a bowl of boiling milk," and the sky was "full of innumerable tiny particles of water torn from the crests of the waves until the air was so thick we could barely see half the length of our vessel." Captain Eric Lindman flinched as waves broke over the pilot house and the seas forced its way "through every fissure, no matter how small, even squirting in through the keyholes in the outer cabin doors." Unlike its ill-fated sisters, however, ***Swiftsure*** survived the intense 12-hour battering.

Storms were certainly not a lightship's only threat. Man, rather than nature, caused the loss of the ***Diamond Shoals Lightship #71*** in 1918 off Cape Hatteras, N.C. A German submarine, provoked by the lightship's radio message warning off shipping, surfaced and, after allowing the 12-man crew to abandon ship, sank it with shell fire. The lightship's sacrifice was not in vain though, for more than 25 Allied ships had received its timely radio warning.

Certainly, dangers posed by weather and collision were ever-present. Official records contain 237 instances of lightships being blown adrift or dragged off-station in severe weather or moving ice. Five lightships were lost under such conditions, but the majority, despite heavy damage to hull and superstructure on many of these occasions, remained on station unassisted. This attests to a high order of seamanship, and commendations for bravery and outstanding ship handling often resulted.

Without regard to frequent minor bumps, sideswipes and near-misses, 150 more serious collisions with lightships are documented. Most of these involved sailing vessels, but long tows of multiple barges accounted for a sizeable number. Collision damage ranged from superficial to severe, and, in at least one case, the lightship came out unscathed, with the colliding vessel going down nearby. On another occasion when a lightship was struck by a passing vessel, the impact was sufficient to knock the on-watch lightship crew from their feet, and shatter all 16 lamp chimneys in the masthead lanterns. Beside the ***Nantucket*** in 1934, four other lightships were sunk as a result of being rammed. Fog was a factor in many of these collisions, however, most occurred under conditions of reasonably good visibility. Vessels attempting to cross the bow of the lightship without making due allowance for current and leeway was found to be the usual cause. A variety of factors contributed to lightships being veritable targets for all traffic. Many were positioned in midchannel. Early charts were overprinted with dotted lines running from lightship to lightship giving the course and distance, and sailing directions in early *Coast Pilots* openly encouraged passing lightships close aboard. Ships' officers handling coasters during the 1800s were by and large sadly deficient in the practice of piloting. Charts were often either not carried at all or were not used for plotting. Instead, reliance was placed on listings of courses, bearings and distance found in a variety of government and commercial publications, or simply passed on by word of mouth. Little wonder that lightshipping carried with it such a large measure of apprehension.

... and sailing directions in early Coast Pilots openly encouraged passing lightships close aboard.

In 1939, the Lighthouse Service along with the responsibility for Aids to Navigation were absorbed by the Coast Guard. Lightship officers and crews, as well

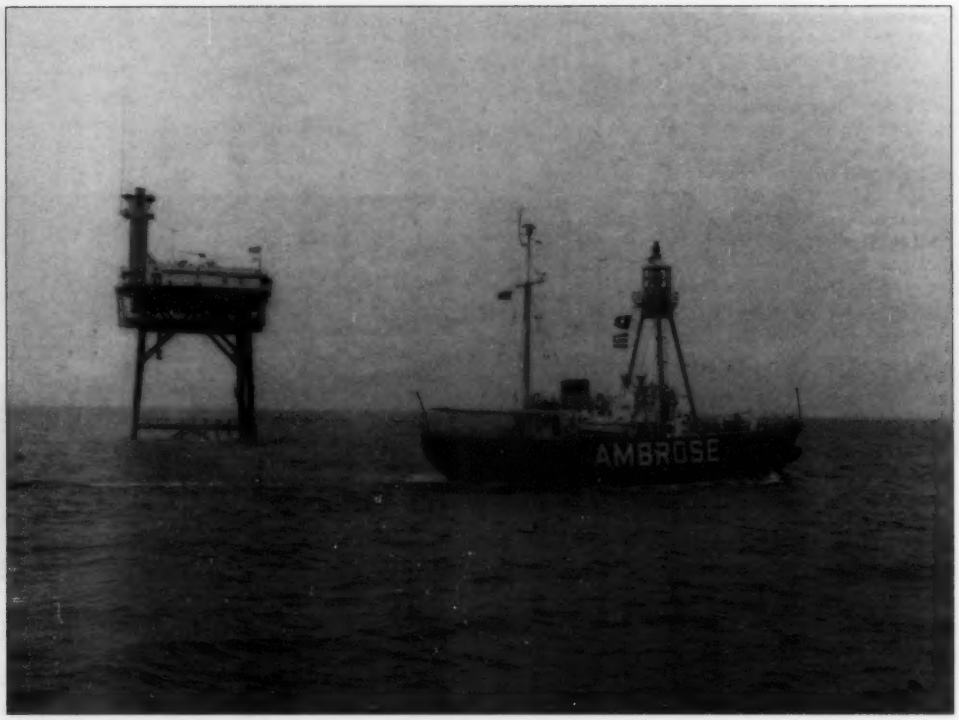
Engineroom duty never ended, only the watch schedule changed, and the smell of diesel fuel was almost as distressing as the motion the engines helped prevent. At left, aboard the ***Winter Quarter Lightship #107*** *fuel oil was used under its boilers. A member of the ship's "black gang" would use a torch to start the main burner.*

At right, the last of the Great Lakes lightships, the ***Huron****, was decommissoned on August 21, 1970 at Port Huron, Michigan. Prior to that it held the distinction of being the oldest active U.S. lightship. It was also the only light vessel that had a black hull, which appropriately designated its position on the port side of the channel.*

as other civilian employees, were offered two choices–integration into the Coast Guard with military rank commensurate with existing salary or retention in civilian status under Coast Guard command. The result was about a 50–50 split. For lightships, many operated initially with either an all–military or an all–civilian complement. This later gave way to a mix of military and civilian personnel. The mixed crews were in evi-

Despite the safety precautions instituted over the years duty aboard the lightships was still an adventure at times. At right, the U.S. Coast Lightship #505 ***Relief****, serving the New York area was rammed in fog by the the freighter* ***Green Bay*** *on June 24, 1960. The lightship was on relief duty at the Ambrose station off New York Harbor. It sank rapidly but all hands were saved.*

Fog was exceptionally persistent and widespread in June of 1960. It was reported on practically all days by vessels along the Atlantic coast from New York to the Grand Banks.



Ambrose Light, another victim of progress, was replaced on August 23, 1967 by the permanent Ambrose offshore light tower. Commissioned August 4, 1952, the 540-ton ***Ambrose*** *was the last U.S. lightship built. Its 700,000-candlepower light, which could be increased to 2.5 million candlepower, was the most powerful of any lightship.*

dence well after World War II and a few of the Lighthouse Service civilian employees were still active into the 1970s. In 1967, the Coast Guard became part of the Department of Transportation.

From 1939 until the end of the lightship era in 1983, the high standards of professionalism and technology introduced by the Lighthouse Service were carried forward and improved upon by the Coast Guard—well in keeping with its long history of dedication to the interests of mariners.

"An important part of Coast Guard history ended today. We must now look somewhere else to find the stuff that sea stories are made of."

March 29, 1985, saw the final chapter of America's lightship era come to a close with the decommissioning of the ***Nantucket I***.

In a farewell message, Coast Guard Commandant ADM James S. Gracey said, "Technology has found a way to replace her with a more cost-effective aid to navigation, but ***Nantucket I***'s sailors can never be replaced."

In many cases lightships were replaced with "Texas Tower" type offshore light platforms, other fixed structures or large navigational buoys, all offering considerable savings in manpower and in construction and maintenance costs.

The last message sent by the ship read in part, "An important part of Coast Guard history ended today. We must now look somewhere else to find the stuff that sea stories are made of."

Most of the decommissioned lightships are long gone. Quite a few were sold and served in coastwise and harbor roles. Two provided bonfires at Fourth of July celebrations and several were used as target ships by the Navy. A few were transferred to other countries for use as lightships, some were used as floating clubhouses by various organizations, but the majority ended up in a shipbreakers yard. However, 19 lightships still survive, the three oldest built in 1904. Most of these veterans remain afloat, restored for use as museums or exhibits open to the public. Two serve as floating restaurants and one is in use in the charter trade.

This cannot end with the traditional look to the future of lightships, for there is none. However, the vessels themselves, and certainly all those who served in them, constitute a unique and proud segment of America's maritime heritage—one sometimes overlooked, but never to be forgotten.

Daring Seafarer Honored

Martin P. Skrocki
U.S. Merchant Marine Academy
Kings Point, New York

The presentation of the Seamanship Trophy is made by Deputy U.S. Maritime Administrator, Joan Yim (right) and U.S. Merchant Marine Academy Superintendent Rear Adm Thomas T. Matteson to Captain Deborah Dempsey.

A shipmaster and her team, lowered from a helicopter to stop an unmanned runaway cargo ship in a fierce storm, are the 24th recipients of the 1994 American Merchant Seamanship Trophy, which recognizes extraordinary seamanship by American mariners.

Captain Deborah Dempsey led a team of three other volunteers who were airlifted to the vessel ***Lyra*** which had broken its tow off the North Carolina coast.

On January 26, 1993, the evacuated ***Lyra***, a Lykes Bros. Steamship Co. vessel under tow from Baltimore to New Orleans, broke loose in heavy seas and began drifting toward Frying Pan Shoals in North Carolina. Although carrying no cargo, the ***Lyra*** carried 387,000 gallons of fuel oil aboard posing a substantial environmental threat.

Dempsey, 43, earlier had been master of the ***Lyra*** for six trips to the Persian Gulf during Operation Desert Storm. Because of her familiarity with the vessel, she was asked by Lykes to volunteer for the mission.

The crew were flown by helicopter to the runaway ship, but because the vessel was displaying 30° rolls, the helicopter could not land on its deck. Instead the team were lowered one by one in 50-knot winds onto the pitching, 193-meter vessel.

Once aboard, Dempsey and the team struggled for some 7 hours to start the ship's emergency generator and lower a pair of 5½-ton anchors to stop the drift, no easy feat in 7-meter running seas.

With the ***Lyra*** finally anchored, Dempsey spent another 3 days aboard to reattach the tow line and start the main generators to pull up the anchors.

Dempsey and her team are credited not only with saving a $22-million vessel but also with preventing a possible oil spill that could have devastated the North Carolina coast.

PMO News

Martin S. Baron
National Weather Service

The NWS provides meteorological equipment such as barometers, barographs, sling psychrometers, wind wheels, and sea water bucket thermometers as a loan to VOS program vessels taking weather observations. This equipment is very expensive and hard to replace. If your vessel stops participating in the program (for example, if your vessel is sold), equipment should be returned. Please contact your PMO whenever your status as a VOS program participant is about to change. Discuss the situation–arrangements for an equipment pick-up, drop-off or delivery may be needed. We have occasionally been unable to recover equipment, especially when vessels end up in overseas shipyards. Since equipment supplies are very limited, please help us ensure that equipment is accounted for and available for new recruits.

Editor Awarded Bronze Medal

NOAA awarded the Department of Commerce Bronze Medal to Mariners Weather Log editor, Dick DeAngelis for outstanding contributions to the worldwide marine community. He was commended for upgrading the content and layout of the Log and transforming the publication into what is thought to be one of the world's foremost sources on marine meteorology. The award was presented by NOAA's leadership at a ceremony in Silver Spring, MD.

New Newark PMO

We are pleased to announce that John Bolinger has been selected as PMO for the port of Newark, New Jersey and will report on March 6, 1995. John has been working as a meteorological technician at Weather Service Office Asheville, North Carolina. I will have more information about John and a photograph in the next MWL (Spring, 1995). The vacancies for PMO New York, and PMO Seattle have not been filled as of this writing. Until these positions are filled, vessels arriving at the port of New York/New Jersey should contact other East Coast PMOs (Baltimore, Norfolk, Jacksonville, Miami (Port Everglades) for supplies.

John Bolinger PMO Newark

New Marine Program Manager for Alaska

Greg Matzen is the new Marine Program Manager for the NWS Alaska Region. Greg received a B.A. in Meteorology from San Jose State University in 1967 and worked for the Air Force before joining the NWS. This is his second NWS Alaska Region assignment (from 1986–1990, he was an aviation/marine forecaster at the Anchorage forecast office). Greg is very excited about returning to Alaska and his new position. He is anxious to make the Alaska marine program as effective as possible.

Vince Zegowitz Aboard the *Patriot State*

Marine Observations Program Leader Vince Zegowitz spent the week of January 9 aboard the

Massachusetts Maritime Academy training ship ***Patriot State***, helping teach students about the VOS program, weather observing and coding. He met the ship in Buzzards Bay, MA, and returned from Barbados.

PMO San Francisco Recovering from Surgery

Bob Novak, PMO San Francisco, is recovering from surgery and was unable to visit ships during part of November and December 1994. He is expected to be back full time by late January, 1995, resuming his normal ship visitation schedule at that time.

Upcoming PMO Conference

Our annual VOS/PMO program meeting will be held in San Diego, CA during late March 1995. The meeting will feature an in-depth review of all program operations and procedures. We are anxious to keep improving the program. Ships officers are strongly encouraged to present their ideas and suggestions to their local PMOs, either in person or in writing. Always feel free to contact us at NWS headquarters in Silver Spring, MD. The names, addresses and phone numbers of all NWS VOS program Staff are indicated on the *MWL* inside back cover.

PMOs Distributing New Forms

As reported in the Summer and Fall, 1994 editions of the Mariners Weather Log (MWL), the World Meteorological Organization has made several changes to the Ships Synoptic Code, which became effective November 2, 1994. Although most of the code has not changed, we had to update and reprint the observing forms (Ships Weather Observations form B-81, Weather Report For Immediate Transmission, Form B-80), and the Ships Code Card. Please continue to report the weather using the forms you have until you receive the new forms.

Port Meteorological Officers are passing out the new forms, dated 6/94. They also have a one page summary of the Synoptic Code changes. If you have not already received these, please contact any United States PMO listed on the MWL inside back cover.

Report Accuracy, Timeliness, and Distribution

Report accuracy and timeliness is so important that I've included it again for review. Ask your PMO questions about weather observing procedures, coding, methods of report transmission, and the proper use of instrumentation. Suggestion: write down your questions and leave them on the bridge near the ships barometer where the PMO will likely see them.

Accuracy – Always make sure your equipment is properly calibrated. A PMO should calibrate your barometer and barograph once every 3 months and also check your psychrometer during every ship visit. Sea water thermometers (whether hull-mounted or located in the condenser intake) should be calibrated annually and checked every time your vessel is in the yard for service. If your vessel has an anemometer, it should be calibrated once every 6 months. Make sure the anemometer is located where the ships superstructure will not interfere with the air motion. When recording dry and wet bulb temperatures, always take your psychrometer to the windward side of the ship. This allows contact with air fresh from the sea which has not passed over the deck prior to your measurement.

Timeliness –Observations must be transmitted without delay as soon as possible after you've observed the data. The meteorologist uses your report as indicative of current, up-to-date conditions at your vessel. Make your observation as close to the reporting hour as you can. Any transmission problems or difficulties with radio stations should be reported to your PMO and written down in the appropriate space on the back of the B-81 Ships Weather Observations form.

Report arrival times tend to be late during the night and in the Southern Hemisphere. Please make every effort to improve the timeliness of these reports.

Distribution–Data are most readily available from the main shipping routes in both hemispheres. There are a chronic shortage of data from coastal waters out 200 miles (for this reason, 3-hourly reports are requested from U.S. and Canadian waters out 200 miles from shore). This area around North America has the highest concentration of

maritime operations. These activities and the concern for safety, require careful attention by weather forecasters producing coastal and offshore forecasts. You can help fill in critical observation gaps with 3-hourly reports. These reports make a big difference in the reliability of the warnings and forecasts. There is also a widespread shortage of data from the Southern Hemisphere and from the Arctic Ocean. More data are also needed from the tropics and easterly trade wind belt (5°-35°N), especially during the Northern Hemisphere hurricane season (May–November). From the North Atlantic and North Pacific Oceans, more data are needed at 0600 and 1200 UTC (these are late night and early morning times). If you are operating from a data-sparse area, please report weather regularly.

Wind Speed Estimates from State of Sea

Please keep these factors in mind when determining wind speed using the Sea-State Beaufort Wind Force Scale. They may require an adjustment to your wind speed estimate:

(1) Heavy rain and floating ice will damp down the sea surface, and can result in an underestimate of wind speed.

(2) There is a lag period between the wind speed increasing or decreasing, and changes in the sea.

(3) Wind blowing against a strong current or tide will cause a greater sea than normal and may result in an overestimate of wind speed.

(4) Wind blowing in the same direction as a strong current or tide will cause a smaller sea than normal and could result in an underestimate of wind speed.

(5) Swell may cause more whitecaps to form because sea waves have a greater tendency to break when superimposed on the crests of swell.

Keep a close, continuous watch on the sea at all times. This makes it much easier to observe and report this important information. Sea State/Wind Speed posters are available from the PMOs.

Guide to Sea State, Wind, and Clouds

A new Brochure, "Guide to Sea State, Wind and Clouds," is now available from the PMOs in limited quantities. The brochure contains 67 color photographs (13 sea state, 54 cloud) to help you determine wind speed and cloud type as reported in Ships Weather Observations. It also contains a glossary with pertinent terms and definitions.

Ships officers can help with future publications by providing us with sea state photographs. These are very hard to come by. Please have them labeled with Beaufort force and wave height. You should also indicate where they were taken.

New Recruits October–December 1994

During the 3-month period ending December 31, 1994, PMOs recruited 46 vessels as weather observers/reporters in the National Weather Service (NWS) Voluntary Observing Ship (VOS) Program. Thank you for joining the program and becoming part of the team.

Please follow the worldwide weather reporting schedule as best you can—report weather four times daily at 0000, 0600, 1200, and 1800 UTC. The United States and Canada have a 3-hourly weather reporting schedule from coastal waters out 200 miles from shore and from anywhere on the Great Lakes. From these coastal areas, please report weather at 0000, 0300, 0600, 0900, 1200, 1500, 1800, and 2100 UTC, whenever possible.

To transmit your weather report to the NWS, use (1) INMARSAT Standard A or Standard C, (2) U.S. Coast Guard Simplex Teletype Over Radio (SITOR), plain language (recite the coded message using radiotelephone), or high frequency Morse Code, (3) commercially operated shore radio stations (using SITOR or CW), as a back-up, if methods (1) or (2) are not available.

NATIONAL WEATHER SERVICE VOLUNTARY OBSERVING SHIP PROGRAM
NEW RECRUITS FROM 01 JULY 94 TO 30 SEPT. 94

NAME OF SHIP	CALL	AGENT NAME	RECRUITING PMO
ADM. WM. M. CALLAGHAN	KGYE	KEYSTONE SHIPPING	NEWARK, NJ
ARIZONA	V2MF	RIISE SHIPPING INC	JACKSONVILLE, FL
ATLANTIC SUPERIOR	C6BT8	T. PARKER HOST	BALTIMORE, MD
BELGRANO	P3HR2	PMO	HOUSTON, TX
BLED	J8EK	SPLOSNA PLOVBA PIRAN	SEATTLE, WA
BLUE SAPPHIRE	ELNV9	REDERI AB SUNSHIP	MIAMI, FL
CARIBBEAN MERCY	3FFU4	MERCY SHIPS	MIAMI, FL
CHEVRON OREGON	WNHL	CHEVRON SHIPPING CO	SAN FRANCISCO, CA
COLUMBUS CANADA	ELQN2	COLUMBUS LINE	LOS ANGELES, CA
CORNELIA MAERSK	OXIF2	MAERSK LINE	NEWARK, NJ
DELMONTE PLANTER	ELIT7	DEL MONTE FRESH FRUIT INTL.	MIAMI, FL
DODGE ISLAND	WYQ7951	NATCO	MIAMI, FL
DOLE COSTA RICA	ICRD	DOLE FRESH FRUIT INTL., LTD.	MIAMI, FL
DOLE HONDURAS	ICWF	STAN. FRUIT & STEAMSHIP CO.	BALTIMORE, MD
E.W. MCKINLEY	3EVY	EASTWIND SHIP MGMNT	MIAMI, FL
EVER RENOWN	3FFR4	EVERGREEN MARINE CORP.	LOS ANGELES, C
FALSTRIA	C6BD8	STAR SHIPPING (U.S.W.C.) INC.	SEATTLE, WA
GEORGE SCHULTZ	ELPG9	J. E. ASPEN SHIPPING CO.	BALTIMORE, MD
GOLD RIVER	LAFO4	WILLARD IVER, INC.	NEWARK, NJ
GULF CURRENT	ELMF9	SINGA SHIP MANAGEMENT	NEWARK, NJ
IBN AL-MOATAZ	HZLH	UNITED ARAB AGENCIES INC	BALTIMORE, MD
ISLA GRAN MALVINA	LQOK	DELEUSA	NEWARK, NJ
JOSEPH LYKES	3ELQ9	LYKES BROTHERS SHIPPING CO.	BALTIMORE, MD
MINERAL OSPREY	ELND2	ANGLO EASTERN SHIP MGMNT	MIAMI, FL
NORTHERN LION	A8IE	NORTH AMERICAN SHIP AGEN.	LOS ANGELES, CA
NOVA ZEELANDIA	C6LA7	NETWORK SHIPPING LTD	MIAMI, FL
OCEANUS OSAKA	3EQZ6	NYK LINE, NA INC.	NEWARK, NJ
ORIENTAL FERM	DZDB	DAKILA OCEAN NAV. CORP	MIAMI, FL
SAN ISIDRO	DIOR	IVARAN AGENCYS INC.	NORFOLK, VA
SEALAND GUATEMALA	OVJV2	BRANDTSHIOP USA, INC	MIAMI, FL
SENORITA	LADN4	UGLAND MARITIME	MIAMI, FL
SERAFIN TOPIC	ELBZ2	NEW ENGLAND SHIPPING CO	BALTIMORE, MD
SONORA	XCTV	OCEANS INTERNATIONAL	HOUSTON, TX
SONORA	XCJT	OCEANS INTERNATIONAL	HOUSTON, TX
SR. DIRECTOR	XXXX1	ESCUELA NAUT DE TAMPICO	HOUSTON, TX
SR. DIRECTOR	XXXX2	ESCUELA NAUT DE VERACRUZ	HOUSTON, TX
TEAL ARROW	C6KB8	WESTFLEET MANAGEMENT	NEWARK, NJ
USCGC STEADFAST	NSTF	COMMANDING OFFICER	SEATTLE, WA
USNS COMFORT	NCOM	MILITARY SEALIFT COMMAND	BALTIMORE, MD
VISAYAS VICTORY	DZVP	STAR SHIPPING (NY) INC	BALTIMORE, MD
VOROSMARTY	HAAT	MASSAN SHIPPING	BALTIMORE, M
WESTERN LION	A8BN	NORTH AMERICAN SHIP AGEN	LOS ANGELES, CA
YUCATAN	XCUY	OCEANS INTERNATIONAL	HOUSTON, TX

This preliminary report is compiled from warnings issued by the National Hurricane Center, Central Pacific Hurricane Center, Naval Western Oceanography Center, Fiji Meteorological Service, Meteorological Service of New Zealand, the Joint Typhoon Warning Center, Japanese Meteorological Agency, Bureau of Meteorology, Australia, Philippine Meteorological Service, Royal Observatory of Hong Kong, Indian Meteorological Department, Reunion Meteorological Service and the Mauritius Meteorological Service.

While an effort has been made to make sure this information is as accurate as possible, it was drawn from operational warnings that may not always agree with the best track information published after the storm is over. A much more detailed summary is available on the Internet. Text copies of past weekly summaries can now be retrieved via FTP from squall.met.fsu.edu. They can be found in the directory pub/jack. Please address any questions or comments to Jack Beven at Internet addresses: beven@hrd-tardis.nhc.noaa.gov or jbeven@delphi.com.

A digitized version of the weekly summary with DMSP polar orbiting imagery is available over the World Wide Web. This is courtesy of Greg Deuel at the DMSP satellite archive. It can be found at: http://web.ngdc.noaa.gov/ under the Weekly Updated Items section of the DMSP Satellite Archive home page.

For more information on the imagery and how to retrieve the digitized summary and images by other methods, please contact Greg Deuel at Internet address: gbd@po-box.ngdc.noaa.gov.

Tropical Cyclone Summary for July, August and September 1994

Jack Beven
National Hurricane Center

North Atlantic Basin

Tropical Storm Alberto: Tropical Depression One formed near 22°N, 85°W on June 30. The next day it reached tropical storm strength. Alberto moved northward on July 2 as it reached a peak intensity of 50 knots and made landfall near Destin, Florida on the 3rd. The KCRD reported 44-knot winds and a minimum pressure of 1004.8 millibars just north of Alberto at 1800 on the 2nd. Alberto moved into Alabama after landfall, and it weakened into a low pressure system late on July 3. The residual low stalled over Georgia and Alabama and was traceable through July 7.

Eglin Air Force Base, Florida, reported sustained winds of 35 knots with gusts to 57 knots at 1521 July 3. The minimum observed pressure was 999 millibars at the same time. Unofficial reports from the Destin area indicate winds gusts up to 75 knots. The main problem with Alberto was heavy rainfall before and after the system was tropical storm strength. Parts of western Cuba received up to 254 millimeters of rain. Heavier rain was reported in Alabama and Georgia, with Americus, Georgia, reporting 533 millimeters. The resulting flooding has claimed 28 lives in Georgia and Alabama. The flood damage is estimated at $100 million.

Tropical Storm Beryl: Tropical Depression Three formed over the northern Gulf of Mexico near 30°N, 88°W on August 14. As a tropical storm, it reached peak intensity of 45 knots late on the 15th as it drifted erratically near Panama City, Florida. The storm weakened to a low pressure area over land late on the 16th.

Beryl was a large system that affected much of the southeastern United States. The strongest winds were well east of the center, with Tallahassee, Florida reporting 46-knot sustained at 0617 on the 16th and a peak gust of 56 knots at 0619. An automated station at Turkey Point, Florida also reported a 56-knot gust at 0548 on the 16th. Beryl's remains also spawned at least 30 tornadoes from Georgia into the Middle Atlantic States.

Hurricane Chris: Tropical Depression 4 formed near 12°N, 40°W on August 16 and reached tropical storm intensity later that day.

Chris slowly strengthened during the next several days and reached a peak intensity of 65 knots. Chris turned northward on the 21st while weakening to minimal tropical storm strength. At the time it was just east of Bermuda generating 35-knot winds. A ship reported 60-knot winds and a pressure of 1001 mb at 1500 on the 17th. Chris turned north northeastward on the 22nd, and became extratropical the following day. Maximum sustained winds increased to 40 knots before the extratropical transition. Buoy 44141 reported a pressure of 1003.4 millibars at 1200 on the 23rd although reported winds remained below tropical storm strength.

Tropical Storm Debby: Tropical Depression Six formed near 14°N, 61°W on September 10. The system reached tropical storm strength later that day. On the 11th it reached a peak intensity of 40 knots. The storm weakened to a tropical wave later that same day near 16°N, 71°W.

Debby affected the islands of Martinique and St. Lucia. Fort De France, Martinique reported 29-knot sustained winds with gusts to 49 knots at 0600 on the 10th. Ship PJRB reported 44-knot sustained winds at 0600 on the 10th. One person was killed on St. Lucia with two other missing. One person was killed on Martinique, and one person drowned off the southwest coast of Puerto Rico. Extensive damage was reported on Martinique and St. Lucia.

Tropical Storm Ernesto: Tropical Depression Seven formed near 11°N, 31°W on September 22. The system reached tropical storm intensity later that day as it headed northward. Ernesto reached a peak intensity of 45 knots on the 23rd and weakened to a depression the next day. Ernesto dissipated near 17°N, 33°W on the 25th.

Eastern North Pacific (east of 140 °W)

Tropical Storm Bud: Tropical Depression 2E formed near 16°N, 113°W on June 27 and reached tropical storm intensity later that day. The following day Bud reached a peak intensity of 40 knots. The cyclone weakened to a depression later that day, and it dissipated on June 28 near 19°N, 124°W.

Hurricane Carlotta: Tropical Depression 3E formed near 11°N, 104°W on June 28. The system reached both tropical storm and hurricane intensity the next day. Carlotta reached a peak intensity of 90 knots on July 1 but weakened to a minimal hurricane on the 2nd and fell to tropical storm intensity on July 3. Moving westward with 40-knot winds, Carlotta began to weaken and fell to a depression on July 4 and dissipated the next day near 21°N, 134°W.

Tropical Storm Daniel: Tropical Depression 4E formed near 12°N, 123°W on July 8. It reached tropical storm strength and a peak intensity of 60 knots the next day. Daniel tracked westward packing 55-knot winds. Daniel continued this course and intensity until it moved into the Central North Pacific near 13°N, 140°W on July 11.

Hurricane Emilia: Tropical Depression 5E formed near 8°N, 132°E on July 16. The system reached tropical storm intensity later that day and reached hurricane intensity on the 17th before moving into the Central North Pacific near 10°N, 140°W with 75-knot winds.

Tropical Storm Fabio: Tropical Depression 6E formed near 13°N, 126°W on July 19. The system reached a peak intensity of 40 knots later that day. Fabio weakened to a depression on the 20th, then turned westward the next day and continued this track as it moved into the Central North Pacific near 17°N, 140°W on the 22nd.

Hurricane Gilma: Tropical Depression 7E formed near 12°N, 123°W on July 21. Moving westward, the system reached tropical storm intensity on July 22 and hurricane intensity the next day. Rapid strengthening continued, and Gilma was packing 130-knot winds when it crossed into the Central North Pacific near 12°N, 140°W on the 24th.

Tropical Storm Hector: Tropical Depression 9E formed near 19°N, 108°W on August 7th and reached tropical storm intensity later the same day. Hector was moving west northwestward with 35-knot winds. On the 8th it reached a peak intensity of 60 knots. The storm rapidly weakened to a depression the next day and dissipated near 26°N, 118°W on August 10.

Hurricane Ileana: Tropical Depression 11E formed near 17°N, 108°W on August 11. The system reached tropical storm intensity later that day, and on the 12th it attained a peak intensity of 65 knots. Ileana weakened on the 13th and dissipated the next day near 27°N, 125°W.

Hurricane John: Tropical Depres-

sion 10E also formed on August 11 near 12°N, 97°W. The system became a tropical storm later that day. John reached 60 knots on the 13th and moved generally westward through the 18th as a poorly-organized storm with 40- to 50-knot winds. John began to reintensify on the 19th and reached hurricane intensity the following day. Further strengthening followed, and by the time John reached 140°W late on the 20th, it was packing 100-knot winds.

John continued to intensify and on the 23rd reached a peak intensity of 150 knots. (This may be revised later.) Although the satellite intensity estimates for John were as high or higher than in Emilia, the lowest pressure measured by reconnaissance aircraft was 929 millibars at 0128 on the 23rd. This is higher than Emilia's 926 millibars. John turned west northwestward on the 24th as it weakened, and this track continued until it moved into the Western North Pacific on August 28. John passed just north of Johnston Island on the 26th with 85- to 90-knot winds. The island reported sustained winds of 49 knots with gusts to 64 knots at 0236 with a minimum pressure of 985.4 millibars at 0436. John's winds dropped to 70 knots later on the 26th, then they increased to 110 knots the following day. As John crossed the International Dateline, it was packing 100-knot winds.

Tropical Storm Kristy: Tropical Depression 13E formed near 15°N, 126°W on August 29. The system reached tropical storm intensity the next day and moved westward into the Central North Pacific near 16°N, 140°W on the 31st. At that time, it was packing 55-knot winds.

Tropical Storm Lane: Tropical Depression 14E formed near 18°N, 109°W on September 3. The next day the system reached tropical storm intensity. On the 5th, it reached hurricane intensity and next day it peaked with winds of 115 knots. Lane weakened to a tropical storm on the 8th and to a depression on the 9th as it reached the Central North Pacific near 21°N, 140°W.

Tropical Storm Miriam: Tropical Depression 15E formed near 14°N, 116°W on September 15. The system reached tropical storm intensity the following day and a peak intensity of 40 knots on the 18th. Miriam headed westward on the 19th but weakened to a depression on the 20th. It dissipated the next day near 15°N, 140°W.

Tropical Storm Norman: Tropical Depression 16E formed near 17°N, 113°W on the 19th. It reached a peak intensity of 35 knots the next day. Norman was moving northward on the 21st when it weakened to a depression, and the system dissipated the next day near 23°N, 118°W.

Hurricane Olivia: Tropical Depression 17E formed on September 22 near 13°N, 110°W and reached tropical storm intensity later that day. Moving west northwestward, it reached hurricane intensity on the 24th. It rapidly strengthened to a peak intensity of 130 knots on the 25th as it turned northward. A NOAA research plane measured a central pressure of 925 millibars at 2033 that day. The actual minimum pressure may have been lower as this flight took place after the system reached its strongest appearance on satellite imagery. Olivia stalled on the 26th near 21°N, 119°W, then on the 27th it weakened to a tropical storm. On the 28th, it weakened to a depression and dissipated the next day near 22°N, 126°W.

Tropical Storm Paul: Tropical Depression 18E formed near 15°N, 129°W on September 25. It reached tropical storm intensity later that day and was nearly stationary near its initial position with 35-knot winds. This turned out to be the peak intensity of the system. Paul drifted northeastward on the 26th and 27th, then on the 28th it weakened to a depression. (The unusual eastward motion was due to interaction with Hurricane Olivia.) Paul drifted east-southeastward on the 30th and it dissipated the next day near 15°N, 122°W.

Central North Pacific (180°W to 140°W)

Tropical Storm Daniel: Daniel entered the Central North Pacific on the 11th of July and continued westward through the 13th while weakening. It dissipated late on the 13th near 17°N, 154°W.

Hurricane Emilia: Emilia entered the Central North Pacific on July 17 with 75-knot winds. Rapid strengthening ensued, and Emilia's winds increased to 130 knots by late on the 18th. On the 19th it reached a peak intensity of 140 knots. On the 22nd it weakened to a minimal hurricane. and by the 24th, Emilia was a depression southwest of the western Hawaiian Islands and dissipated on July 25 near 22°N, 167°W.

Emilia is the strongest hurricane of record in the Central North Pacific. Reconnaissance aircraft measured a minimum central

pressure of 926 millibars on several occasions on the 19th and 20th. This was lower than the 937-millibar aircraft pressure in Hurricane Iniki in 1992. One remarkable feature was the rapid rise in central pressure during weakening. At 0500–0600 on the 21st, the pressure was measured at 936 millibars and 30 hours later, it had risen to 990 millibars. Emilia passed over buoy 51002 as it weakened. The buoy measured sustained winds of 47 knots with gusts to 60 knots at 0800 on the 22nd. A minimum pressure of 990.1 millibars was observed 2 hours later

Tropical Depression Fabio: Fabio entered the Central North Pacific near 17°N, 140°W on the 22nd, with 25-knot winds. The depression continued westward until it dissipated near 17°N, 154°W on the 24th.

Hurricane Gilma: Gilma entered the Central North Pacific near 12°N, 140°W on July 24th. It continued westward and late in the day the storm reached an estimated peak intensity of 140 knots. Weakening began on the 25th, and by the time reconnaissance aircraft reached Gilma that day the central pressure had risen to 965 millibars. Maximum sustained winds at this time were around 100 knots. Weakening, Gilma began to recurve and on the 29th passed south of Johnston Island where several gusts near 35 knots were reported. Gilma weakened to a depression on the 30th, and it dissipated near 19°N, 176°W the next day.

Hurricane Li: Tropical Depression 8E formed near 13°N, 126°W on July 31. It moved into the Central North Pacific near 12°N, 140°W on August 3. The system continued westward until it dissipated near 11°N, 156°W on the 5th. It regenerated and became Tropical Storm Li near 14°N, 167°W on August 8. Gradual strengthening occurred and Li reached a peak of 65 knots on the 11th. It crossed the International Dateline near 12°N early on the 12th when it weakened to a tropical storm. Li weakened to a depression on the 15th, then it slowed to an erratic drift the next day. Li continued to drift aimlessly until it dissipated near 17°N, 170°E on the 18th.

Hurricane Kristy: Kristy entered the Central North Pacific on August 31, with 55-knot winds. Strengthening continued, and Kristy reached hurricane intensity later that day. Kristy moved westward on September 1 as it reached a peak intensity of 90 knots. On the 2nd it weakened to a minimal tropical storm and fell to depression status the following day. The system continued westward and dissipated on the 5th near 15°N, 165°W.

Tropical Storm Mele: Tropical Depression 2C formed near 11°N, 165°W on September 6. It reached a peak intensity of 35 knots on the 7th. Mele weakened to a depression the next day, then it dissipated near 14°N, 177°W on the 9th.

Western North Pacific (west of 180°W)

Typhoon Tim: Tropical Depression 8W formed near 13°N, 130°E on July 7. The next day it reached both tropical storm and typhoon intensity. Tim continued to intensify rapidly reaching a peak of 125 knots before it hit Taiwan on the 10th. Tim continued into China and dissipated over land on July 11.

Tim seriously affected Taiwan and China. Taipei, Taiwan reported 55-knot sustained winds with gusts to 82 knots at 1400 on the 10th. Hsinchun reported a minimum pressure of 971 millibars at 2100 July 10th. Press reports indicate that seven people died on Taiwan with six others missing. Damage is estimated at $69 million. Tim produced 3 deaths and $172 million dollars of damage in China.

Tropical Storm Vanessa: Tropical Depression 9W formed near 16°N, 116°E on July 9 and reached tropical storm intensity later that day as it remained quasi-stationary. Vanessa started moving north-northeastward through the South China Sea on the 10th in response to Typhoon Tim approaching Taiwan. There were several ship reports of 25- to 40-knot winds. Vanessa reached a peak intensity of 45 knots on the 10th. The storm dissipated later on the 11th near 23°N, 119°W.

Tropical Storm Walt: Tropical Depression 10W formed near 11°N, 129°E on July 14. The system reached tropical storm strength on the 16th. Walt reached typhoon intensity on July 18, followed by rapid strengthening to a peak intensity of 130 knots on July 19. On the 21st it weakened to a tropical storm and slowed to an erratic drift near 30°N, 132°E on the 23rd. Walt passed near buoy 21004 on July 22, which reported 44-knot sustained winds at 0100 and a pressure of 975.7 millibars at 0600. Also, Muruotomisaki, Japan reported 49-knot sustained winds at 2100 on the 24th. The storm turned north northwestward across southwestern Japan on the 25th, with Shimiza reporting a 985.5-mil-

libar pressure at 0300. Walt moved into the East China Sea on the 26th as it weakened to a depression. It dissipated near 34°N, 127°E on the 28th.

Tropical Storm Yunya: Tropical Depression 11W formed near 16°N, 118°E on July 18. The system reached tropical storm intensity later that day before tracking across the northwest corner of Luzon. Vigan reported a pressure of 992.8 millibars at 2300 on the 18th. Yunya moved into the Philippine Sea on the 19th as it reached a peak intensity of 45 knots. It weakened to a depression on the 20th and it dissipated the next day near 21°N, 134°E.

Typhoon Zeke: Tropical Depression 12W formed near 22°N, 137°E on July 17. The depression reached tropical storm strength on the 19th and maintained 35- to 40-knot sustained winds until the 21st. Zeke reached a peak intensity of 65 knots on the 21st. This was based on a 65-knot ship report near the center. Zeke weakened to a tropical storm the next day and became extratropical on the 25th near 44°N, 162°E.

Tropical Storm Amy: Tropical Storm Amy (TD-15W) formed rapidly from a persistent area of low pressure near Hainan Island on July 29. The system drifted westward on the 30th as it reached a peak intensity of 40 knots. Amy moved into Vietnam on the 31st and dissipated.

Tropical Storm Brendan: A tropical depression formed near 16°N, 129°E on July 26th. The system reached minimal tropical storm intensity later that day. On the 28th, it began a northward drift and accelerated across Okinawa on the 30th. On the 31st, Brendan approached the west coast of the Korean peninsula with 45-knot winds. The ***Taurus*** reported 32-knot sustained winds and a pressure of 999.7 millibars at 0600 on the 28th. Naha on Okinawa reported a minimum pressure of 995 millibars around 1600 on the 30th. Brendan moved across the Korean peninsula on August 1, weakened to a depression before turning eastward and moving across northern Japan on the 2nd. Brendan dissipated near 41°N, 149°E on the 3rd. Press reports indicate that Brendan's passage caused 8 deaths. Twenty people were reported missing.

Tropical Storm Caitlin: A tropical depression formed near 19°N, 131°E on July 31. Catlin reached tropical storm strength the following day and a peak intensity of 55 knots prior to moving across Taiwan on the 3rd. Caitlin continued into China the next day and dissipated over land.

The ***DSR-Baltic*** reported 44-knot sustained winds at 0000 on the 4th. Kaohsiung International Airport on Taiwan reported 32-knot sustained winds with gusts to 42 knots at 0802 on the 3rd. Chang Kai-Shek Airport near Taipei reported a 53-knot gust at 1200 that day. Press reports indicate that eight people were killed on Taiwan with four missing.

Super Typhoon Doug: Tropical Depression 17W formed near 15°N, 145°E on August 1. On the 3rd, Doug achieved both tropical storm and typhoon status. Doug began to recurve as it reached a peak intensity of 140 knots on the 6th. The storm passed near Taiwan on the 7th and maximum sustained winds had decreased to 95 knots by that time.

On the 9th Doug weakened to a tropical storm. The system weakened to a depression on the 12th before it made landfall over China, and it dissipated over land later that day.

Doug seriously affected Taiwan and the southwestern Ryukyu Islands. Ishigakijima, Japan reported 52-knot sustained winds at 1200 on the 7th while Chang Kai-Shek Airport, Taiwan reported 43-knot sustained winds with gusts to 60 knots at 1800. Hulien, Taiwan reported a gust to 74 knots at 2000. Press reports indicate that 12 people were killed on Taiwan with 6 others missing.

Typhoon Ellie: A tropical depression formed near 26°N, 145°E on August 7 and drifted slowly westward on the 8th when it reached tropical storm strength. On the 10th it became nearly stationary near 23°N, 139°E. On the 11th Ellie reached typhoon intensity. It moved through the northern Ryukyu Islands while reaching a peak intensity of 75 knots on the 13th. The typhoon continued through the Yellow Sea the next day, packing 65-knot winds.

Ellie's initial development took place on the 9th near Iwo Jima Island where a minimum pressure of 989 millibars with sustained winds of 36 knots and gusts to 53 knots were reported. Ellie also affected southern Japan and the Ryukyu Islands. Tanegashima Island, Japan, reported a minimum pressure of 983.2 millibars on the 12th while Kanoya, Japan reported 43-knot sustained winds with gusts to 62 knots the following day.

Super Typhoon Fred: Tropical Depression 19W formed near

18°N, 145°E on August 14 and reached tropical storm strength the next day. Fred reached a peak intensity of 130 knots on the 19th. The typhoon moved through the southern Ryukyu Islands on the 20th with 115-knot winds, then moved into China on the 21st, still generating 80-knot winds. The system continued inland and dissipated the next day.

Fred seriously affected China, the southern Ryukyu Islands and Taiwan. Ishigakijima Island, Japan, reported a minimum pressure of 941.6 millibars at 1200 on the 20th, with sustained winds of 50 knots at 1800. Miyakojima Island, Japan, reported 53-knot sustained winds and a pressure of 967.9 millibars at 1200 that same day. Funding, China, reported a minimum pressure of 978.5 millibars at 1500 on the 21st, while Shipu, China reported 51-knot sustained winds at 1200 the same day.

Press reports indicate that more than 1000 people were killed in China. Some 500,000 homes were damaged or destroyed and damage estimates are up to $1.2 billion dollars. One person was reported missing from Taiwan.

Typhoon Gladys: Tropical Depression 20W formed near 24°N, 175°E on August 22. It reached tropical storm intensity on the 24th and typhoon intensity the following day The cyclone reached a peak intensity of 70 knots on the 26th and then it weakened back to a tropical storm the next day. Gladys started to reintensify on the 30th and regained typhoon strength on the 31st. It reached a peak intensity of 90 knots later that day. Gladys moved across Taiwan into China on September 1, making it the latest in a series of tropical cyclones that have plagued this region. The storm weakened to a low pressure system over China the next day.

Gladys passed near Minamitorishima Island, which reported 45-knot sustained winds at 1200 on the 25th. Chiang Kai Shek airport in Taipei reported 30-knot sustained winds with gusts to 53 knots at 0300 September 1. In China, Mazu reported 35-knot sustained winds at 1200 on the 1st.

Press reports indicate that 6 people were killed on Taiwan with 50 injured.

Tropical Storm Harry: Tropical Depression 21W formed over the South China Sea near 18°N, 119°E on August 25. The system reached tropical storm strength late on the 25th and a peak intensity of 60 knots just before moving across Hainan Island on the 27th. Harry moved into Vietnam on the 28th and weakened rapidly over land.

Haikou, China reported a minimum pressure of 990.0 millibars at 1500 and 1800 on the 27th, while Phu Lien, Vietnam reported a pressure of 994.0 millibars at 1800 on the 28th. Mong Cai, Vietnam reported 30-knot sustained winds at 1200 on the 28th.

Tropical Storm Ivy: A tropical depression formed near 20°N, 165°E on August 27. The system reached tropical storm strength on the 28th. On the 31st Ivy reached a peak intensity of 75 knots. The cyclone weakened to a tropical storm on September 1 and became extratropical near 45°N, 170°E on the 4th.

Typhoon John: Hurricane John crossed the International Dateline near 22°N on August 28 and was renamed a typhoon. John packed 95-knot winds and on the 30th its winds increased to 110 knots. The next day John weakened and by the 31st was a tropical storm. John drifted to the southeast on the 3rd near 26°N, 178°E. The maximum sustained winds were estimated at 35 knots by the Joint Typhoon Warning Center and the Japanese Meteorological Agency, but the ***Sea-Land Spirit*** suggests the system was stronger. It reported 55-knot sustained winds with a pressure of 991.2 millibars at 1500 on the 4th.

John has set a world record for tropical cyclone longevity. It lasted for 30 days (tentatively), which breaks the old record of 27.25 days set by Atlantic Hurricane Ginger in September-October 1971.

Tropical Storm Joel: A tropical depression formed in the South China Sea near 16°N, 114°E on September 3. The system moved westward the next day as it reached tropical storm strength. Joel drifted northwestward on the 5th, then it moved across Hainan Island the next day as it reached a peak intensity of 45 knots. Joel moved into northern Vietnam on the 7th and dissipated.

Typhoon Kinna: Tropical Depression 24W formed near 21°N, 142°E on September 5 and reached tropical storm intensity later that day. Kinna moved northward on the 8th, attained typhoon strength on the 9th and reached a peak intensity of 80 knots the next day. The storm turned north northeastward on the 11th east of Japan packing 70-knot winds. Kinna became extratropical the next day near 42°N, 152°E.

Tropical Storm Luke: A tropical depression formed near 14°N, 128°E on September 7. The system

reached tropical storm intensity the next day, turned west northwestward on the 9th, and the next day moved into the Luzon Strait. The ***Japan Linden*** reported 39-knot winds with a pressure of 1000.5 millibars at 0600 on the 8th. Luke reached a peak intensity of 55 knots on the 12th. The storm moved across Hainan Island later on the 12th, then across the Gulf of Tonkin and into Vietnam on the following day. Luke dissipated over Vietnam on September 14.

Typhoon Melissa: Tropical Storm Melissa developed rapidly near 9°N, 162°E on September 11. The storm reached typhoon intensity on the 13th and continued a rapid intensification. On the 15th Melissa reached a peak intensity of 145 knots. After this peak, it steadily weakened and fell to tropical storm strength by the 18th. Melissa was a large system with tropical storm force winds covering a 300- to 600-mile diameter. Minamtorishima Island reported a minimum pressure of 985.1 millibars at 1500 on the 16th, even though Melissa's closest approach was about 160 miles. Ship OYSN2 reported a pressure of 972.5 millibars at 1200 on the 18th, with maximum sustained winds of 48 knots 6 hours later.

Tropical Storm Nat: Tropical Depression 27W formed near 14°N, 144°E on September 15. The depression reached tropical storm strength the next day and on the 17th attained a peak intensity of 45 knots. It moved northward on the 20th and weakened to a depression on the 22nd. The system dissipated later that day near 31°N, 152°E.

Typhoon Orchid: TD 28W was detected southwest of Guam with 35-knot winds. The system was named Orchid by the Joint Typhoon Warning Center on September 19 and on the 20th it reached typhoon intensity. The typhoon interacted with a monsoon surge on the 22nd and this caused a west-southwestward motion. It began to recurve the next day. Orchid reached a peak intensity of 135 knots on the 25th. The storm moved across Japan and into the Sea of Japan late in the month. It weakened to a tropical storm on the 29th, and it became extratropical later the next day near 42°N, 133°E.

Orchid affected much of Japan. Muruotomisaki reported 64-knot sustained winds and a pressure of 979.7 millibars at 0600 on the 29th. Owase reported a minimum pressure of 972.7 millibars at 1200, while Nagoya reported a peak gust of 69 knots at 1400. Press reports indicate three people were killed with 32 hurt due to Orchid's passage. However, the storm appears to have brought welcome rain to Japan, which was suffering from a summer drought.

Typhoon Pat: Tropical Depression 29W formed near 16°N, 167°E on September 21. The system reached tropical storm strength later that day and typhoon strength on the 22nd. It reached a peak intensity of 95 knots. Pat began to slowly weaken on the 24th. The next day, Pat and the newly-formed Tropical Storm Ruth rotated around each other (Fujiwhara interaction). Pat's track changed from a rapid west northwestward motion to a southwesterly track. Rapid weakening occurred during this day, and maximum sustained winds decreased to 45 knots.

Tropical Storm Ruth: Tropical Depression 30W formed near 20°N, 156°E on September 24. The system reached tropical storm strength the next day as it and Pat rotated around each other. Ruth's northeastward motion changed to northward and then to rapidly west northwestward during the day.

Pat and Ruth were southeast of Japan rotating around each other. Both systems had 45-knot winds. The two systems merged into one storm near 31°N, 150°E on the 26th. Which of the two centers actually absorbed the other is uncertain, as the Japanese Meteorological Agency called the merged system Pat while the Joint Typhoon Warning Center called it Ruth. The combined Pat/Ruth turned northeastward on the 27th with 40- to 45-knot winds, and the system became extratropical the next day near 40°N-159°E.

This merger of two tropical cyclones is unusual. The last such recorded occurrence in the Western North Pacific was in 1986, when Typhoon Tip absorbed the remains of Typhoon Georgette.

North Indian Ocean

No tropical cyclones (tropical storms or hurricanes).

South Indian Ocean (west of 135°E)

No tropical cyclones.

South Pacific Ocean Basin (east of 135°E)

No tropical cyclones.

Marine Weather Radiofax Update

Paul Jacobs
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The broadcasting of weather and oceanographic charts to ships via high frequency (HF) radiofax is an important component of marine weather dissemination for safety of life and property at sea. There are over 60 radio stations around the world making these broadcasts covering a large segment of the world's oceans.

In the United States and its territories, there are nine radiofax broadcast stations operated by the U.S. Coast Guard, the Navy and other Department of Defense (DOD) echelons, and several private marine communications companies. Six of these stations broadcast NWS and National Ocean Service (NOS) charts. They are located in Marshfield, Massachusetts (NMF); Mobile, Alabama (WLO); Pt. Reyes, California (NMC); Kodiak, Alaska (NOJ); Honolulu, Hawaii (KVM-70); and Rogers City, Michigan (WLC). The Navy broadcasts its own weather and oceanographic charts from three facilities: Cutler, Maine (NAM); Pearl Harbor, Hawaii (NPM); Guam (NPN).

On January 31, 1994, the NWS in cooperation with the U.S. Coast Guard, expanded the content and schedule of weather and oceanographic charts on the North Atlantic marine radiofax broadcast from station NMF, Marshfield, Massachusetts. All products are broadcast simultaneously on 6340.5 KHz and 12,750.0 KHz. These frequencies replaced 342.5 KHz and 7530.0 KHz on May 2, 1994.

The new schedule is an increase from 8 to 27 charts. It was designed to provide complete coverage and information on NWS warnings and forecasts and NOS ocean analyses for the North Atlantic to meet the needs of shipping, fishing, and other commercial, recreational, and scientific maritime activities.

In September 1995, the Navy will discontinue their HF radiofax broadcasts as they convert to satellite communication of weather graphics that will be accessible only to military users. Although over the years, many civilian marine users have been able to tune in to the Navy's broadcasts, the mission of these broadcasts has been to support fleet operations and NATO units. Therefore, the NWS and NOS had no involvement in the decision to discontinue the broadcasts. In particular, the Navy's broadcast from Norfolk, Virginia (NAM), was shifted to Cutler, Maine, in March 1994, and the frequencies were cut back to 3357 KHz and 10,865 KHz.

Fortunately, the NWS and the Coast Guard have substantially expanded the Coast's Guard radiofax broadcast from Marshfield, Massachusetts (NMF) and changed to new frequencies for more reliable reception. For further information, contact the following office:

National Weather Service, NOAA
Marine and Applied Services
Branch, W/OM12
1325 East-West Highway
Silver Spring, Maryland 20910
Tel: (301) 713-1677, Ext. 126
Fax: (301) 713-1598

All times unless noted are UTC (universal time) and all miles are nautical. For additional detail, tropical cyclones will be covered in the annual reports from the tropical cyclone centers around the world and in Hurricane Alley. The weather summaries are based upon the track charts and Northern Hemisphere Surface Charts as well as ship reports and attempt to highlight the most significant ocean features each month. The track charts are provided by NOAA's National Meteorological Center. If an extratropical storm is particularly bad for shipping, we may designate it as the Monster of the Month.

–ed.

North Atlantic Weather
July, August and September 1994

July–The Azores–Bermuda High was about where it should be on the climatic charts, just slightly weaker than normal over the western North Atlantic. However the Icelandic Low, which is normally unrecognizable in July, was definitely a factor in 1994 as can be seen in the negative (dark shading) anomalies and the closed center just southwest of Iceland. This trough was also reflected in the mean 500 millibar chart. The result was a fairly rough summer month for mariners and fishermen in the waters south of Iceland.

The month opened with a large 1030–millibar High dominating most of the North Atlantic. Tropical storm Alberto was disrupting shipping in the Gulf of Mexico and a weak Low was heading toward England.

The first organized Low to affect shipping emerged from the St. Lawrence River on the 6th. After becoming part of a complex low pressure system that stretched to England, it took over on the 8th as its 990-millibar center crossed the 55th parallel near 30°W. It remained nearly stationary but intensified slightly during the next few days. On the 8th, gales were reported by the ***Canadian Liberty*** (46.7°N, 36.6°W) in 5–meter seas while the ***Frithjof*** (57.9°N, 36.3°W) ran into 49–knot northerlies. Finally on the 10th the system began to move slowly northward and weaken.

The storm was followed by a Low that developed south of Kap Farvel on the 12th. It headed northeastward and was joined by another center on the 13th. The second system had originated over the Great Lakes on the 9th. Both were moving northeastward and passed on either side of Iceland. The ***Donnington*** (54.6°N, 09.9°W) reported 40–knot south southwesterlies at 1800 on the 13th. By the 15th, the Great Lakes center had fizzled while the other was north of 70°N.

The next real weather action took place from the 22nd to the end of the month in the northeastern North Atlantic and involved several centers. On the 22nd, a 988–millibar Low developed near 55°N, 37°W. It had redeveloped from a weak system near Kap Farvel. It drifted east-

ward then turned northward on the 24th while another center formed to its northwest. On the 26th at 0000, the MSBM4 (63.0°N, 20.3°W) hit a 40-knot easterly in 4-meter swells; they measured a 983-millibar pressure. This was right near the center of a 980-millibar Low which had moved in from the mid Atlantic and absorbed the other two centers into its circulation. At 0300 on the 28th, the ***Canmar Ambassador*** (50.9°N, 8.6°W) ran into 41-knot westerlies. After this Low moved northeastward across Iceland on the 27th and into the Norwegian Sea the following day, another Low was moving in to take its place. Its 990-millibar center passed south of Greenland on the 28th, dipped to 982 millibars the following day and turned northward toward Iceland. It crossed Iceland on the 30th before weakening as the month came to a close.

Casualties—The 58-meter passenger-ferry, ***Islander***, collided with a 22-meter fishing vessel in near-zero visibility near Martha's Vineyard, Massachusetts in early July. There were no injuries reported to passengers or crew on either vessel. On the 23rd the tanker ***Palawan Island*** capsized 150 miles southwest of Kingston, Jamaica. Weather in the area at the time consisted of 15- to 20-knot winds and 2- to 3-meter seas. The crew of 16 were rescued by a passing vessel.

August—As is normal to the Azores-Bermuda High dominated the North Atlantic on the mean surface pressure charts. In fact a look at the anomaly pattern indicates that it was even more dominant than normal except in the Bay of Biscay region. In the Labrador Sea-Baffin Bay area surface pressures were slightly lower than normal, reflecting an unusual amount of cyclonic activity over these waters.

August opened with no less than seven low pressure centers found north of 45°N. Most were weak and unorganized. The most organized was a 1001-millibar center near 49°N, 27°W which was generating 20- to 30-knot winds within 300 miles of its center. The ***Green Bay*** (45.2°N, 33.5°W) at 1200 encountered 30-knot north northwesterlies. The Low weakened and moved eastward on the 3rd.

Another weak Low moved over these same waters on the 8th. A 1004-millibar center was analyzed near 45°N, 17°W at 1200. Once again winds were in the 20- to 30-knot range with swells ranging from 2 to 5 meters. The system moved slowly east northeastward over the next several days, making its way into the Bay of Biscay on the 10th. By that time, however, it had lost most of its identity. At this time a large multicentered low pressure system was hovering over the Labrador Sea and Gulf of St. Lawrence. This system was just strong enough to generate some unpleasant weather across the northern shipping lanes. Once again, however, wind reports remained below gale force.

One of the more organized systems of the month developed over southern Hudson Bay on the 13th. This 995-millibar Low dipped southward across southern Quebec before turning east northeastward and reaching the Labrador Sea by the 16th. Its pressure dropped to 972 millibars as well. Winds in the area approached gale force and 20- to 25-knot winds were common along the associated front. Swells of 2 to 3 meters were being encountered. The Low began to fill as it moved eastward. By the 17th it was absorbed into a weak system south of Iceland.

About the time Tropical Storm Chris was developing in the tropical North Atlantic. It became a hurricane by the 19th on a west-northwestward heading. After recurving on the 21st and 22nd, Chris weakened and turned extratropical on the 24th. However, it maintained an identity up until the time it approached Ireland on the 25th. It was basically one of a series of atmospheric waves that moved along a front which extended from near Ireland to Florida. The front was actually associated with a Low which had intensified near Kap Farvel. By the 27th its 984-millibar center was moving north of Scotland through the Norwegian Sea, with a cold front extending through the North Sea. Winds of 20- to 25-knots were common. The system slowed and absorbed a couple of other minor atmospheric waves and was able to maintain its identity into the 29th when it moved across Norway.

Before the month was finished a large Low originally from Montana blossomed on the 28th over the Great Lakes. By 0000 on the 29th, its central pressure fell to 986-millibars and its circulation extended to the Gulf of St. Lawrence and the Gulf of Maine. The following day, a 990-millibar center emerged into the Labrador Sea where it slowed and weakened.

Casualties– A 140–meter wooden dry dock sank in stormy seas south of Long Island on the 23rd while being towed to Tampa Bay, Florida by the 4,300–horsepower tug, ***Colonel***. The vessel was experiencing gales and heavy seas at the time.

September–The Azores–Bermuda High was not quite the force it usually is over the northwestern North Atlantic and from the Bay of Biscay to the Baltic Sea on the mean surface pressure chart. At the same time, there was little indication of an Icelandic Low either. The first half of the month was more cyclonically active than the second. At the 500–millibar level a slight troughing was noticeable south of Greenland and also from England to Gibraltar with some ridging in between.

A storm that was detected over New York State as the month opened, moved south of Newfoundland on the 2nd and developed into a 976–millibar Low the following day. By 0000 on the 4th, its 969–millibar center had crossed the 55th parallel near 35°W and was heading northeastward. The ***Malla Arctica*** east of the center was encountering strong gales throughout the 4th and at 1500 near 59.0°N, 15.2°W estimated seas at 8 meters. The storm slowed near Iceland the following day and its central pressure was estimated at 968 millibars. The ***Cumulus*** (53.0°N, 18.7°W) ran into 40–knot south southwesterlies while battling 5–meter swells at 1400 on the 5th.

Meanwhile off the southeast coast of the U.S. another Low intensified and created problems, particularly for coastal shipping. From the 4th through the 6th, winds in the 35– to 40–knot range were common and swells ranged from 3– to 6–meters. Ships reporting included the ***Crown Jewel***, ***Del Monte Trader***, ***Sam Houston***, ***Export Freedom*** and ***Madison Maersk***. The 990–millibar system moved up the coast and was off Cape Cod by 0000 on the 6th. On the 7th, both this system and the previous one began to weaken.

During the middle of the month two separate storm systems created problems from the Gulf of St. Lawrence to the Baltic.

The westernmost Low had developed on about the 12th, over Newfoundland but took a couple of days to get it together. By the 14th, it was a large well–organized system with a 982–millibar center located near 50°N, 45°W. The northern European storm began life off Kap Farvel on the 11th but it was a relatively weak storm that made its way to the English Channel by the 14th. There it combined with another weak system and by the 15th it was a large 978–millibar single–centered storm. The two systems were split by a wedge of high pressure. The English Channel storm caused the most problems as a multitude of vessels and rigs in the North and Norwegian Seas ran into 40– to 50–knot winds in 3– to 8–meter seas. Typical of reports from the 15th through the 17th was one from the ***Thalassa*** (55.6°N, 00.5°E) at 0600 on the 16th. They measured 46–knot northerlies in 6–meter seas. The Newfoundland Low, on the other hand, was generating winds of less than gale force and weakened significantly by the 17th.

The North Atlantic remained relatively peaceful until the 24th when a 990–millibar Low near mid ocean created a disturbance. Gales and strong gales were reported by the ***Thompson Lykes***, ***Star Evviva*** and ***Export Patriot*** in the vicinity of 38°N, 45°W. Both the ***Thompson Lykes*** and ***Star Evviva*** encountered 6–meter seas as well. While this system did not intensify further, it meandered through these waters for the next several days generating near gale force within 400 miles of the center.

Casualties–A nine–barge sand and gravel tow broke apart in the relatively confined waters at Hampton Roads, Virginia during a late September storm which was generating 60–knot gusts and 2–meter seas. At least two of the 36–meter barges drifted into the Monitor–Merrimac bridge tunnel. Four New England fisherman died when their 24–meter dragger, ***Italian Gold***, capsized in a September storm about 100 miles east of Provincetown, Massachusetts. On the morning of the 11th, the 190–meter Liberian–flagged bulk freighter, ***Ducegulf***, ran hard aground while running downbound on the St. Mary's River in northern Michigan. Reports indicate the grounding may have occurred in heavy fog. Two Faeroese fisherman drowned when the vessel, the ***Sjoborgin***, sank after hitting rocks in heavy fog off the north coast of Scotland on the 2nd. Two other crewmen were rescued.

North Pacific Weather
July, August and September 1994

July–The climatic chart for the month was dominated by the massive subtropical high, which was pretty close to normal. The Aleutian Low was nowhere to be found although some troughing did occur over the Bering Sea as can be seen in the isobar contours and the negative anomalies. The 500-millibar mean chart showed a trough with an axis south of Kamchatka and another over the Gulf of Alaska.

As the month opened, Hurricane Carlotta was threatening shipping and fishing in the eastern North Pacific. The subtropical high was in place and a large complex low pressure system covered the Sea of Japan, Sea of Okhotsk and shipping lanes to and from Tokyo. Its associated frontal system was generating gales and strong gales. This was substantiated by the ***Virginia*** (46.0°N, 160.7°E) at 1200 on the 3rd with measured 41-knot easterlies in 2-meter swells. The system drifted southeastward and at 0000 on the 4th, the ***President Truman*** (44.8°N, 171.7°E) encountered 40-knot southeasterlies in 4-meter swells. The system remained a thorn in the side of vessels throughout the entire first week as it drifted and centers formed and dissipated. It was bucking a large 1039-millibar High to the east and remained west of the dateline until it finally worked its way north and into the Bering Sea on the 9th. By this time Typhoon Tim was clobbering the northern Luzon.

The semistationary High remained as a blocking force and another trough developed from the Kurils to Kyushu on the 11th. The Lows associated with this feature were mostly weak but did provide some weather in this region. On the 14th no less than five low centers were analyzed between the Sea of Japan and western Bering Sea. There was just enough weather to produce some hardships. For example, on the 15th at 0600 the ***Pacific Aries*** (45.8°N, 173.6°E) measured 42-knot south southwesterlies in a 4-meter swells. The following day the JKPS (45°N, 177.1°W) reported 49-knot westerlies in 3-meter seas.

Finally on the 15th, an organized Bering Sea storm appeared on the weather charts. The 984-millibar center moved eastward and within a day several more centers were found, but the circulation remained organized and extended to about 45°N. A few gale reports were received and on the 16th at 1800 the ***Miller Freeman*** (55.7°N, 161.3°W) reported a 50-knot easterly, 990-millibar pressure and 2-meter swells. At the same time storm force winds were also reported in the Gulf of Alaska by the ***Arco Texas*** (57.1°N, 141.2°W). The system continued to push eastward and remained a factor until the 19th. In the tropics at this time Hurricane Emilia and Tropical Storm Fabio were haunting the eastern waters while Supertyphoon Walt along with tropical storms Yuna and Zeke were dominating the west. A stationary 995-millibar Low was boxed in over the southeastern Bering Sea by a large subtropical High with multiple centers. This situation remained fairly static until the 23rd. The following day Zeke turned extratropical and headed for the western Bering Sea. Hurricane Gilma had entered the weather picture in the east. On the 27th, former Tropical Storm Zeke was a 978-millibar Low east of the Kamchatka Peninsula. However, as it continued northward it began to dissipate. The month came to a close with a large subtropical High dominating most of the Pacific and a 994-millibar Low residing in the central Bering Sea.

Casualties—Four people were missing after the vessel ***88 Princess*** sank in turbulent waters in the Central Philippines on the 8th. The ship was battered by high winds and heavy seas some 400 miles south of Manila. Thirteen people including 10 crewmembers were rescued by the passing ship, ***Virginia***. Also on the 8th, the passenger/cargo vessel ***Santa Lucia De Bohol*** sank off Cabilao Island in the Philippines. Thirty-nine passengers and crew rescued while three were reported missing. Both these incidents were

related to Typhoon Tim.

During Typhoon Brendan at the end of the month, 24 fisherman were missing after two trawlers sank in rough seas off the island of Cheju, Korea. Two were rescued.

August—The subtropical high on the mean surface pressure chart was even more extensive than normal, pushing farther northward into the Gulf of Alaska and westward over Japan as can be seen by the positive anomalies in these areas. The Sea of Okhotsk was more cyclonically active than is normal during this summer month, evidently reflecting the blocking action of the semipermanent subtropical high. At 500 millibars the mean geopotential heights indicated a trough extending from eastern Siberia southward to the mid North Pacific. This is an indication that the steering currents tended to turn any storms towards the Gulf of Alaska and the Bering Sea once they crossed the dateline.

In actuality the extratropical storms were few and mostly in the Bering Sea. Tropical activity included Tropical Storms Ellie, Fred, Ivy and Typhoons Doug and Gladys in the west with Hurricane Kristy and John along with Tropical Storm Li in the east.

The month opened with a 986-millibar Low over the Northern Bering Sea trailing a cold front across the Alaska Peninsula and southward into the mid North Pacific. Its progress was blocked by a huge 1030-millibar High centered over the eastern North Pacific with its circulation pushing across Alaska. Several minor atmospheric waves formed along this front creating some weather disturbances along the northern shipping lanes but not much.

On the 5th, with Typhoon Doug on the loose in the Philippine Sea, a low pressure system over the Kamchatka Peninsula got better organized. Along with its associated frontal system, it created a few minor headaches particularly in the Bering Sea and over the northern shipping lanes. It remained nearly stationary for several days with a central pressure hovering around the 986-millibar mark. At 1200 on the 6th, the ***Dorothea Oldendorff*** near 50°N, 165°E ran into gales in 3-meter seas. The system began to weaken on the 7th. At this time Typhoon Doug in the South China Sea and Tropical Storm Ellie in the Philippine Sea were ruling the tropics.

However on the 8th, a disruptive extratropical storm began to take shape near 48°N, 167°E. It had formed a day earlier over Sakhalin Island but looked like just another weak summertime atmospheric wave at first. By 0000 on the 8th, the central pressure had dropped to 986 millibars and it was lbecoming a well organized Low. Several vessels south of the center were reporting near gales, including the ***Hanjin New York***. Seas were running 2 to 3 meters. The storm turned from a southeastward track and began heading toward the northeast. By 1200 on the 9th, the now 972-millibar center was crossing the 55th parallel just east of the dateline. Station 70454, 300 miles to the south, reported 30-knot southwesterlies as did several nearby ships. The system remained potent on the 10th. As it turned northward toward the Bering Strait, it finally weakened on the 11th as Doug weakened over China and Ellie became a typhoon approaching southern Japan.

A large semipermanent High continued its hold on weather east of the dateline; several weak to moderate lows came to life in the west and by the 15th Tropical storms Fred and Li were the weather features of interest. Fred became a typhoon by the 17th as Li weakened.

During the second half of the month, the influence of the subtropical high pushed westward and most of the cyclonic activity was confined to the Bering Sea and Sea of Okhotsk. Tropical activity was plentiful.

Casualties—On the 9th, the 214 meter cruise ship, ***Nieuw Amsterdam***, grounded in thick fog with strong currents on Gravina Point in Nichols Passage while en route to Ketchikan. The 34,000-gross-ton ship was carrying 1,225 passengers and 500 crewmembers. There were no serious injuries although one passenger claims to have been bruised when knocked off a toilet at the time of grounding.

Typhoon Doug was responsible for the collision of the ***Wen Ching No. 10*** and ***Tung Hai No. 6*** in Kaohsiung Harbor. All crewmen escaped safely. Also the mv ***Batangas***, carrying plywood, ran aground in the vicinity of Aparci in the Philippines during Doug. The 4,426-ton mv ***Chrysanthi*** was reported missing on the 11th after developing engine trouble during a storm in the South China Sea. The vessel was last heard from on the 8th.

September—Two words accurately describe the North Pacific climactic chart for September—nearly normal. The Aleutian Low was centered over the Alaska Peninsula, slightly deeper than normal while the subtropical high dominated most of the subtropical Pacific. Pressures in the western North Pacific were slightly below normal reflecting the abundance of tropical activity around Japan.

The tropical cyclone activity was reflected on the mean 500-millibar chart by a trough digging from Korea and Japan into the western North Pacific. A second trough extended south southwestward from the Alaska Peninsula.

The month opened with a large subtropical high blanketing the eastern North Pacific, several pesky Lows to the east and north and three tropical cyclones covering the waters between Hawaii and Japan. On the 4th, a 988-millibar Low over the Kamchatka Peninsula along with the extratropical remnants of Tropical Storm Ivy were abutting a portion of the subtropical high to the east, and the tightening gradient was causing some strong winds and heavy seas near the dateline from between 45°N and 50°N. The ***Brooklyn Bridge*** (47.7°N, 174.4°E) ran into 43-knot south southeasterlies in 4-meter seas at 1800 on the 4th. Nearby the ***Sea-land Enterprise*** with a 985.4-millibar pressure measured 42-knot southerlies in 6-meter seas. The following day, the NOAA ship ***Miller Freeman*** (59.0°N, 165.5°E) hit 43-knot easterlies in 3-meter seas, and the ***President Jackson*** was running in gales and 3-meter swells. By 1200 on the 4th, the remnants of Ivy had a 976-millibar central pressure. It gradually absorbed the Kamchatka Low, and the system stalled east of the Kamchatka Peninsula. It fell apart on the 6th.

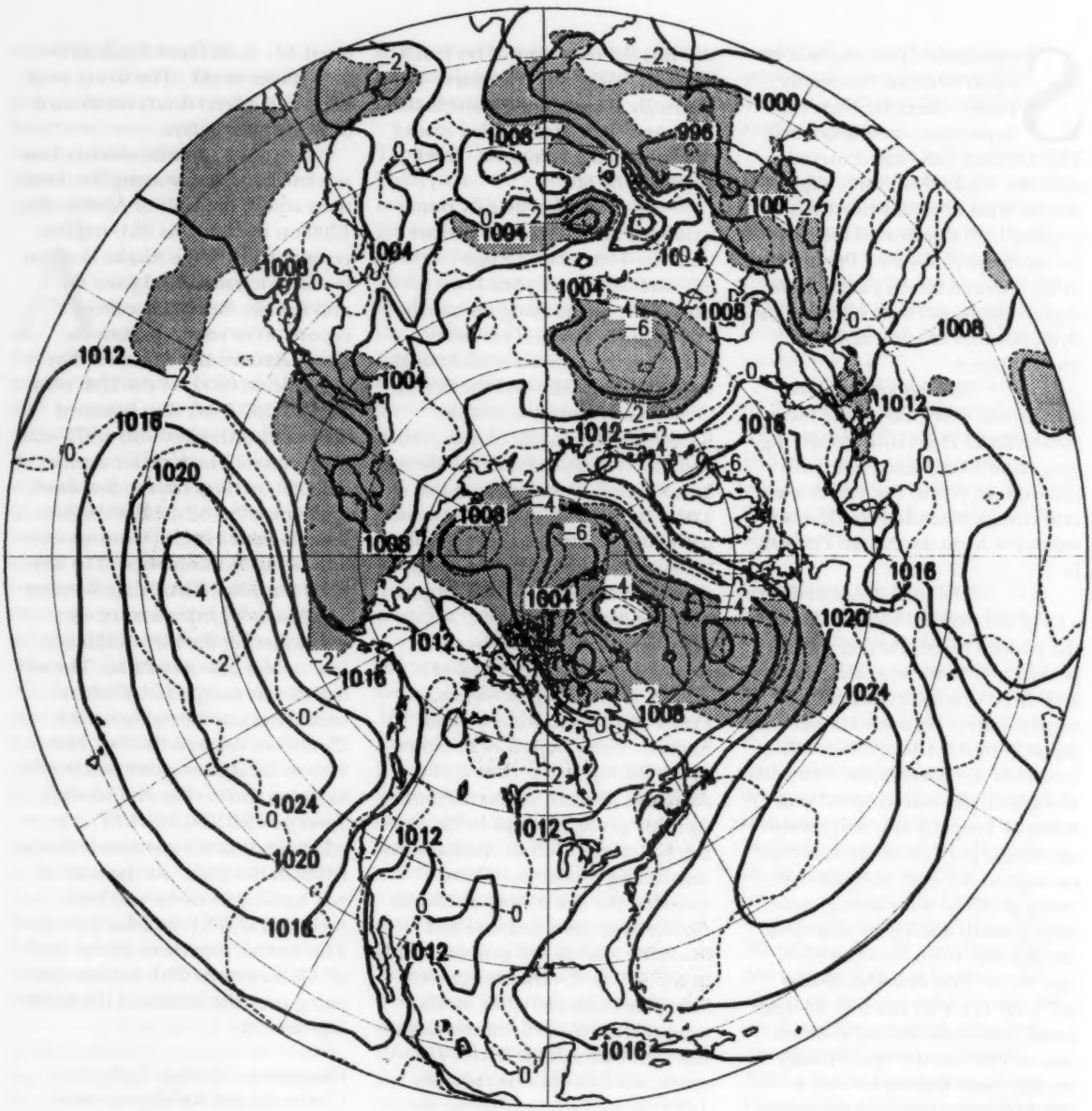
Tropical activity dominated the Pacific weather picture until the 14th when a huge 969-millibar Bering Sea Low caused problems along the northern shipping lanes. This Low began on the 8th as a weak frontal wave over Sakhalin and the Sea of Okhotsk. It moved across the Kamchatka Peninsula on the 10th and finally eastward into the Bering Sea, where it blossomed, on the 12th. By 1200 on the 13th, its central pressure dropped to 981 millibars and 24 hours later it was down to 964 millibars and centered over the Alaska Peninsula. A raft of vessels were affected by this storm, including the ***President Adams***, NOAA ship ***Surveyors***, ***Prince of Tokyo 2*** and ***Sea-land Kodiak***. These vessels were either in the Bering Sea or close to the Aleutians just east of the dateline. Another group of ships in the eastern half of the Gulf of Alaska were also having problems. These included the ***Sun Viking***, ***President Hoover***, ***Sea-land Reliance*** and ***Mathilde Maersk***. In general, winds in the 35- to 45-knot range were being encountered while swells ranged from 3- to 5-meters from the 14th through the 17th. The storm was most potent from the 1200 on the 14th to 0000 on the 16th.

Former Typhoon Melissa became a potent 964-millibar extratropical storm east of Japan on the 18th. The ***Sealand Voyager***, ***Prince of Ocean*** and ***President Jefferson*** all north of the center encountered 40- to 45-knot winds in 5- to 7-meter swells. The storm weakened as it edged slowly northward over the next 2 days.

Meanwhile another Low was causing trouble along the Aleutians and in the Gulf of Alaska. By 1200 on the 20th, its 964-millibar center was over the Alaska Peninsula where it had moved from the mid Pacific. Several excellent reports were received from the ***Green Rainier*** and ***Panama***. For example, at 0800 on the 20th near 54.3°N, 167.7°W, they reported 38-knot northerlies with a 977-millibar pressure in 4-meter swells. At 0000 on the 21st, the ***Sea-land Anchorage*** (56.8°N, 149.6°W) battled 10-meter swells, 6-meter seas and 40-knot southerlies. The ***Keystone Canyon***, NOAA ship ***Surveyor*** and ***Sea-land Express*** were also encountering the fury of this system on the 21st and 22nd. The situation was compounded when another storm moved in on the 23rd from the mid Pacific. This 970-millibar Low generated winds to storm force. The NOAA ship ***Surveyor*** (54.1°N, 161.4°W) reported 56-knot north northeasterlies at 0300 on the 23rd. At the time it was battling 4-meter seas and recorded a 975.1-millibar pressure. This system tore through the Gulf of Alaska on the 24th before weakening over the mainland the following day.

Casualties— During Typhoon Gladys the mv ***Kalidas*** en route from Hong Kong to Taiwan, was slammed into Taiwan's rocky east coast. This action caused the vessel to take on water and start to leak. The 40-member crew was evacuated from the grounded ship, which was eventually sold for scrap.

July 1994



These Northern Hemisphere Mean and Anomalous Sea Level Pressure Charts were provided by John Kopman and Vernon Kousky of the Climate Analysis Center from the Climate Diagnostics Bulletin. Mean values are denoted by solid contours drawn at intervals of 4 millibars. Anomalies (contour intervals of 2 millibars) are departures from the 1979–1988 base period monthly means. Negative anomalies of less than 2 millibars are indicated by the dark shading while positive anomalies of greater than 2 millibars are indicated by the light shading. The analysis should be treated with caution in regions of elevated terrain.

August 1994

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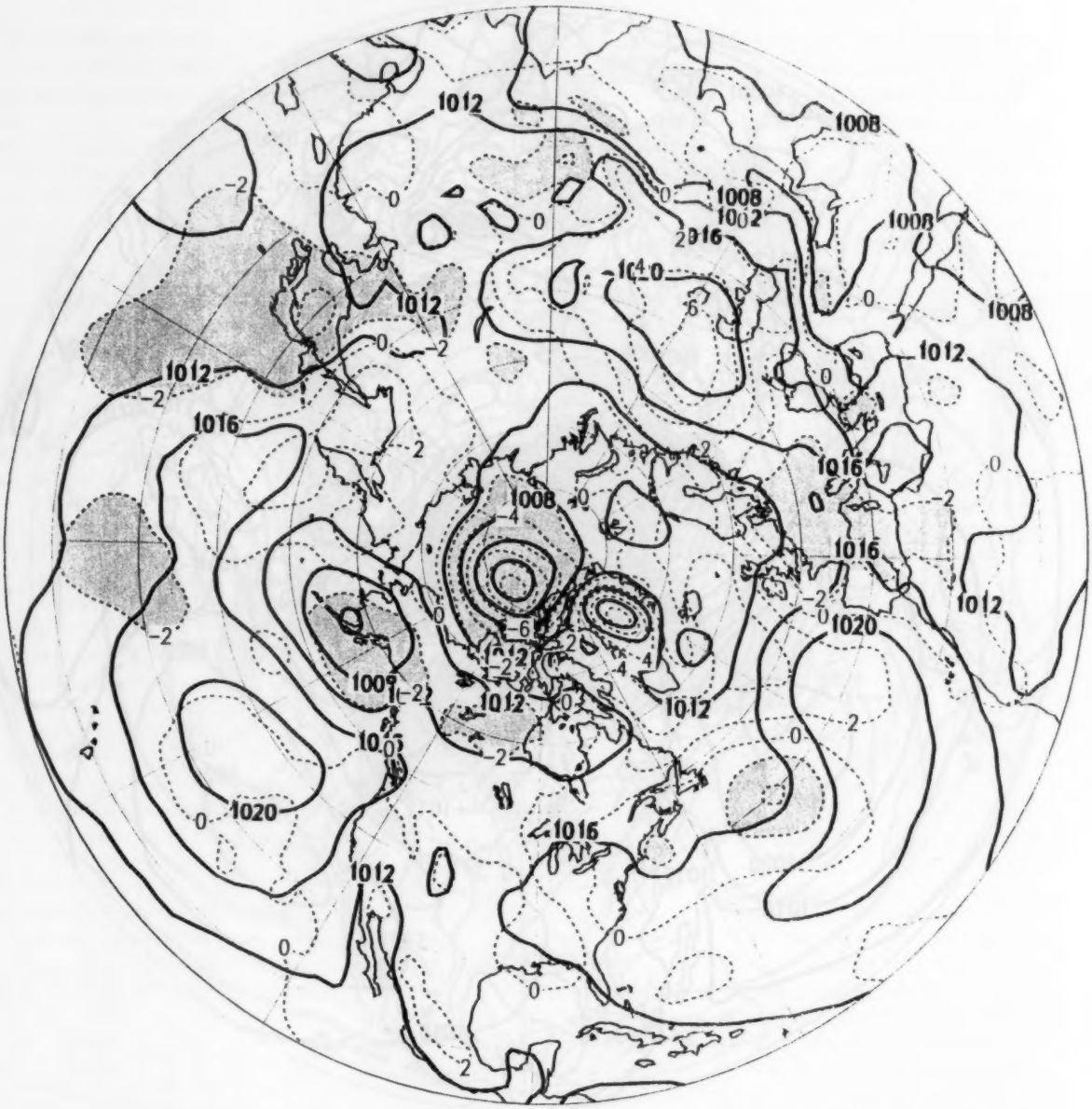
September 1994



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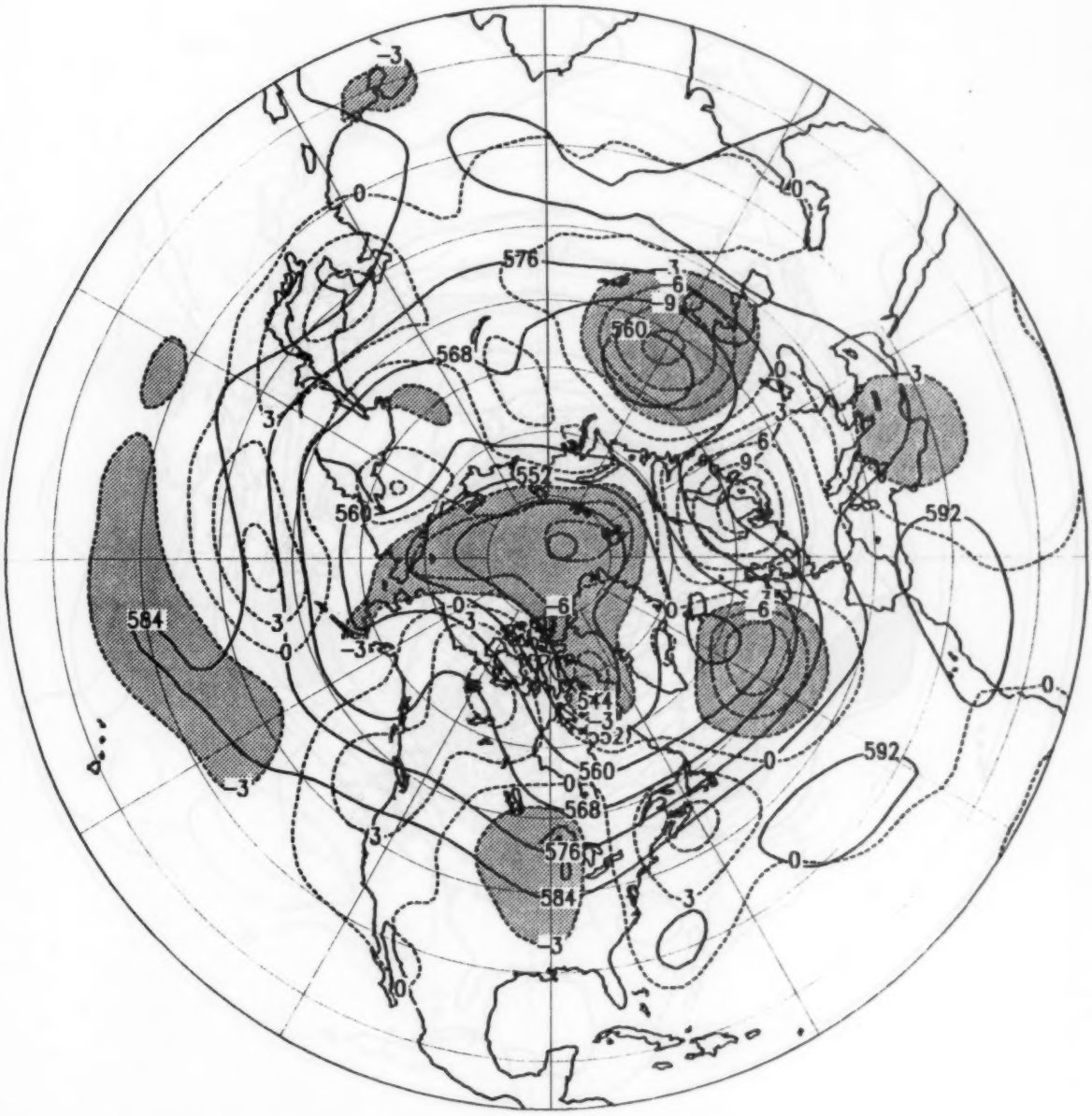
July 1994



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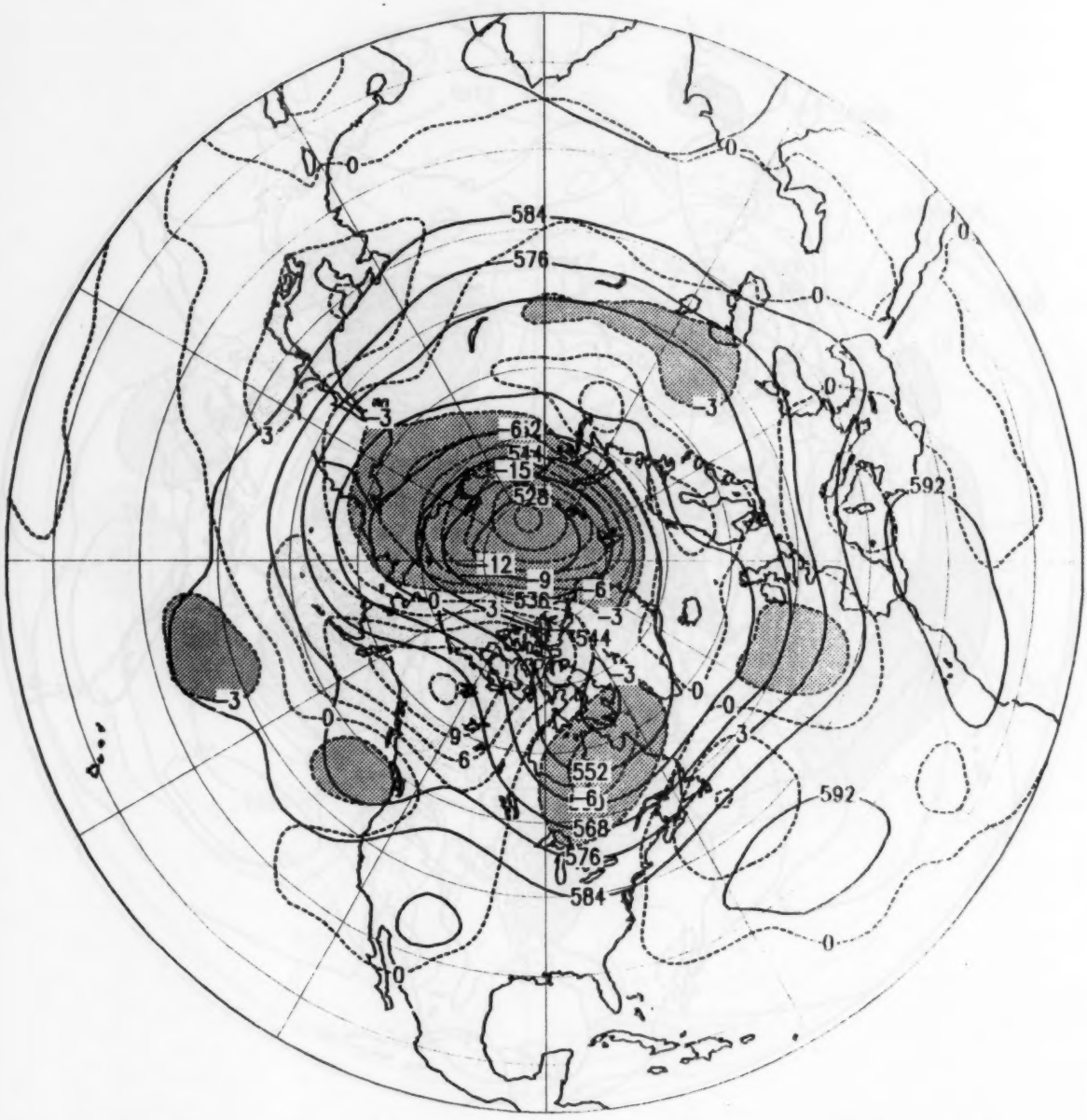
August 1994



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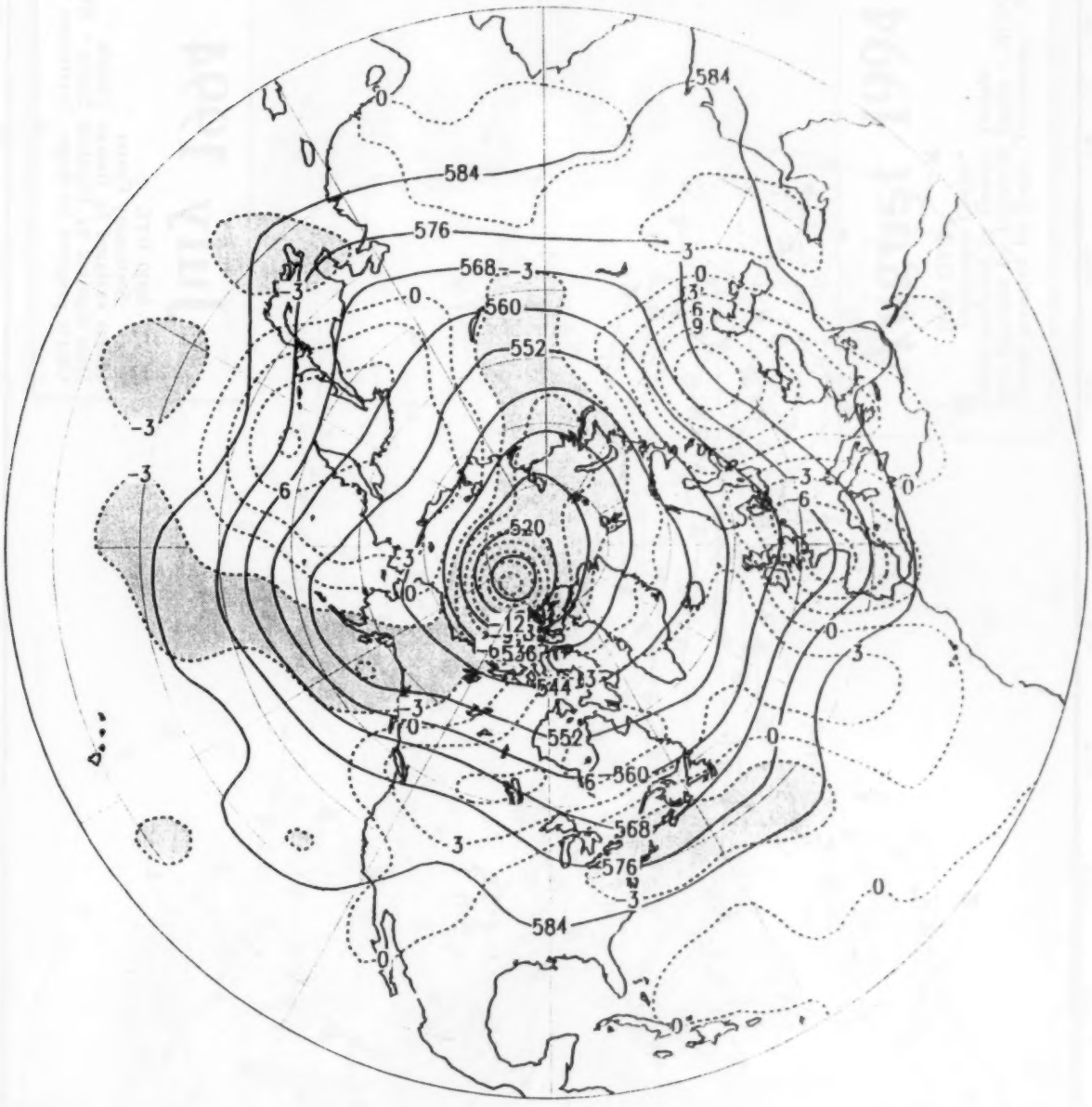
September 1994



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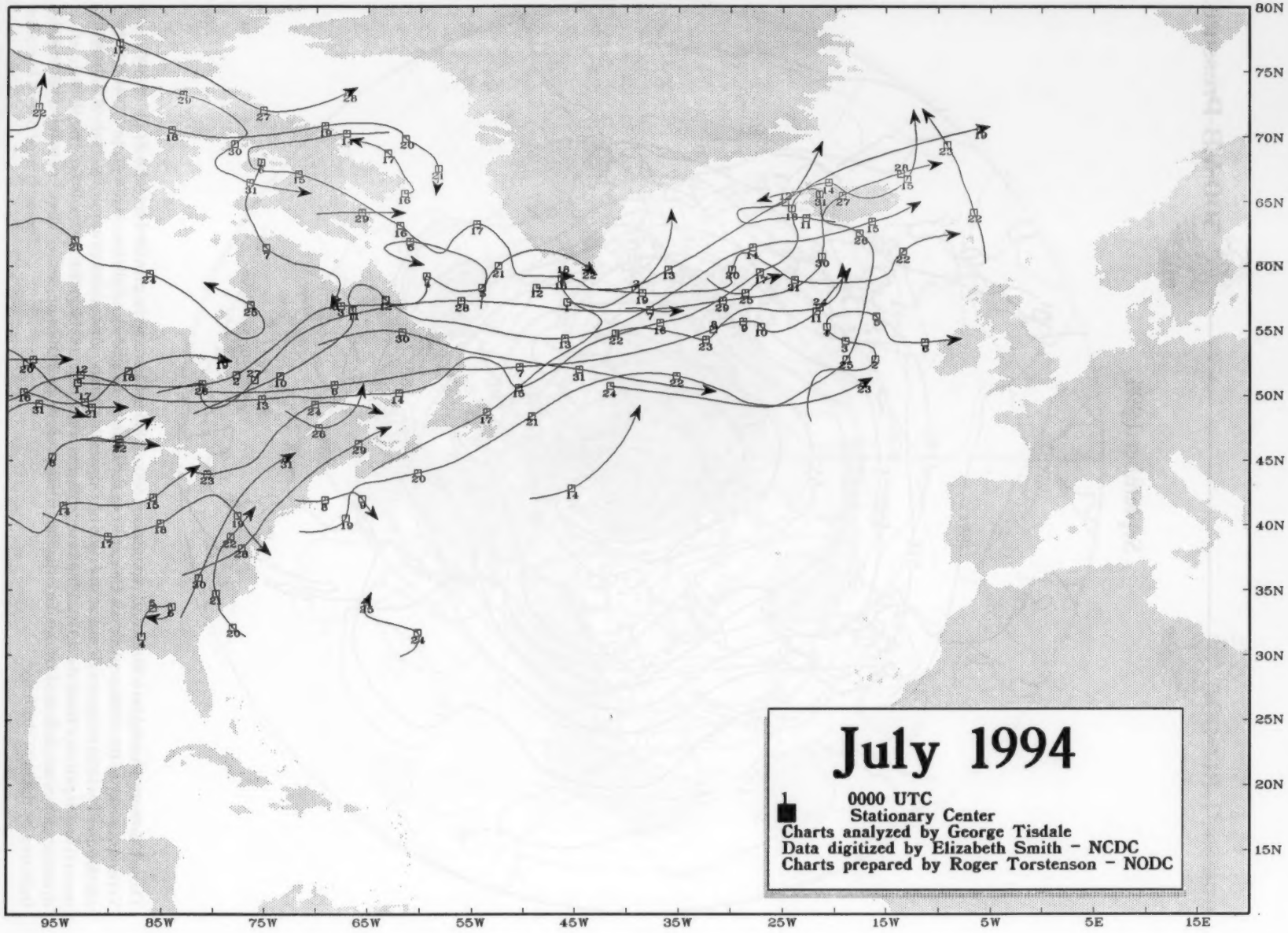
Principal Tracks of Cyclone Centers at Sea Level, North Atlantic



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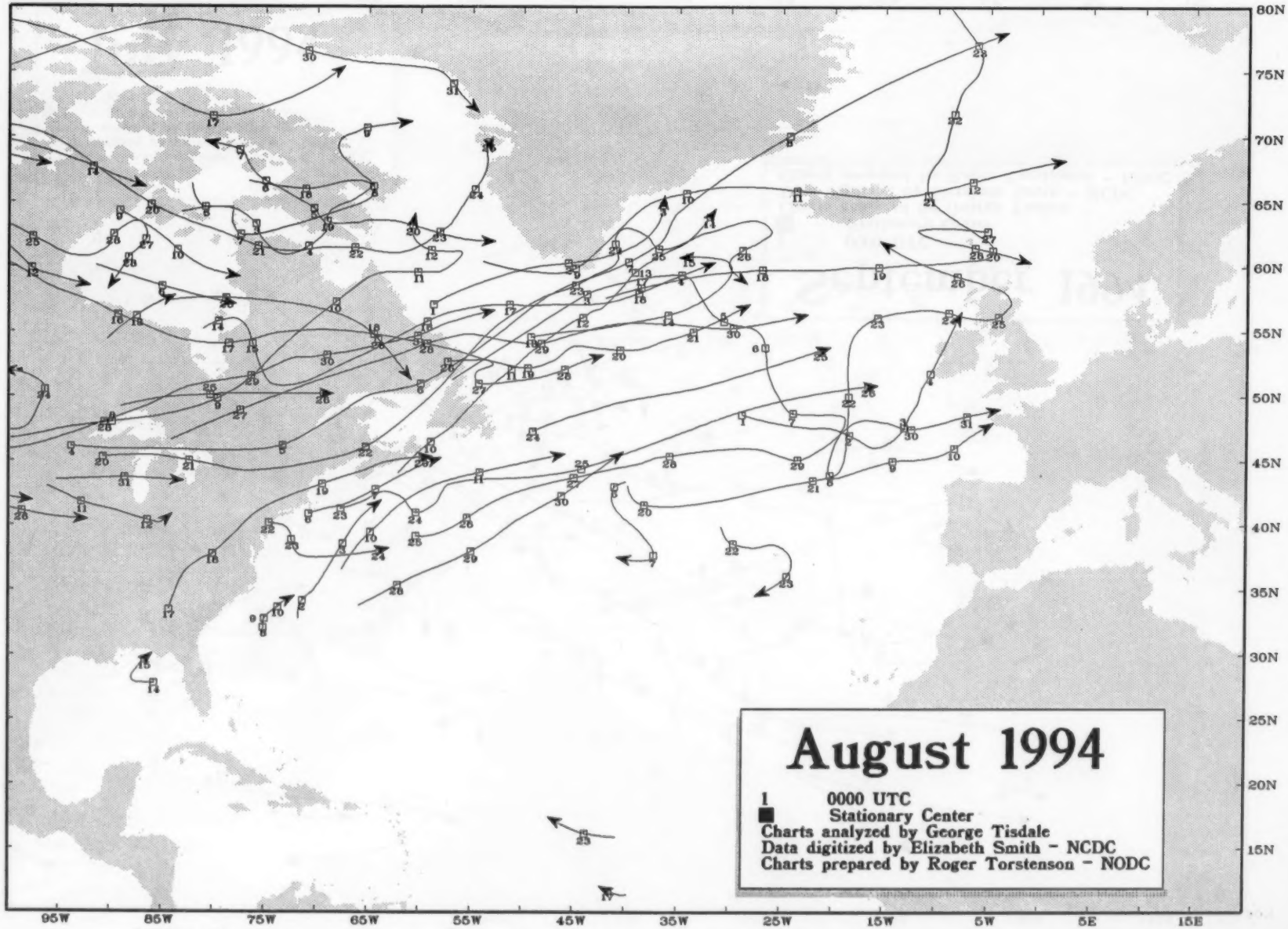

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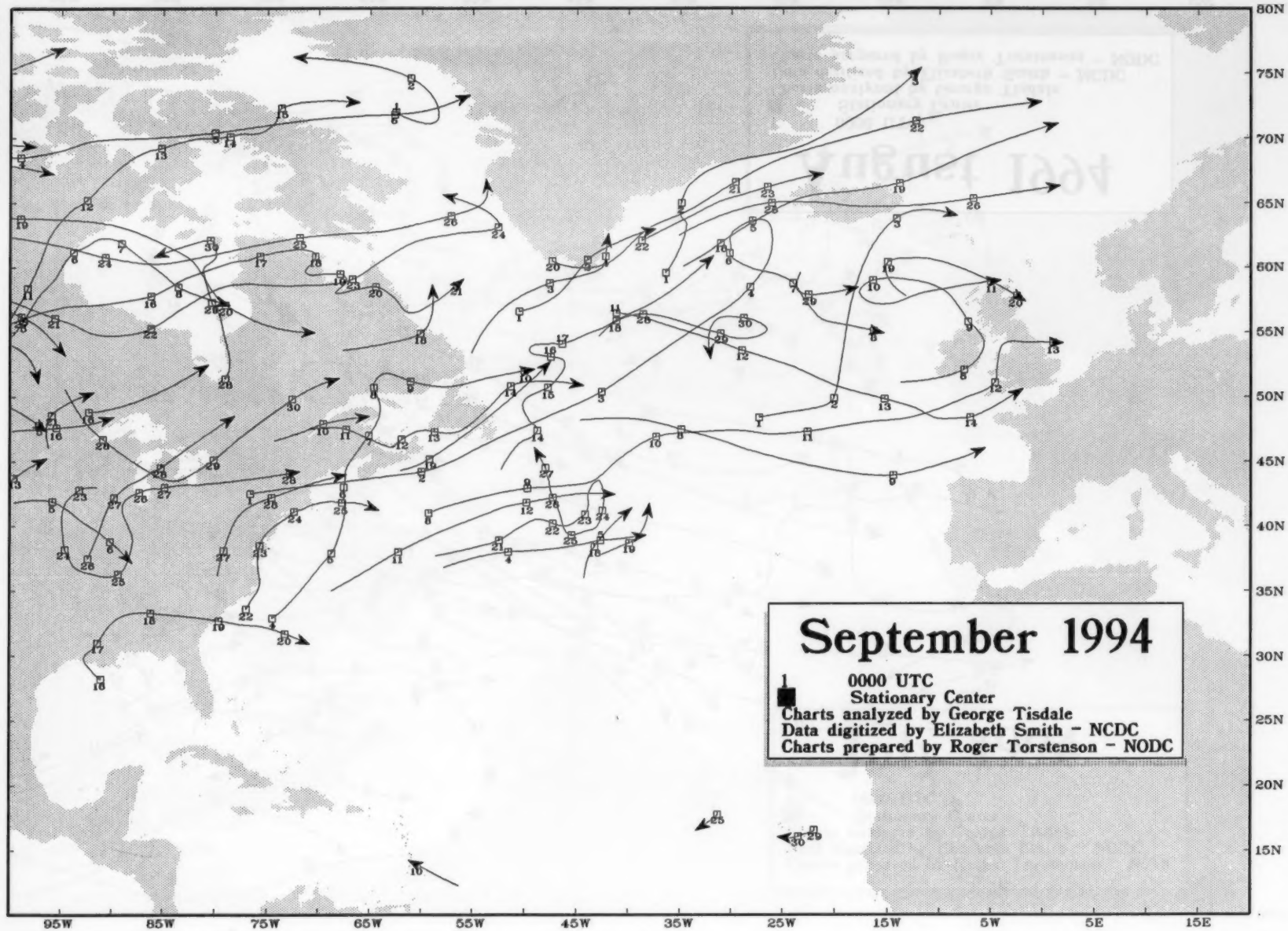
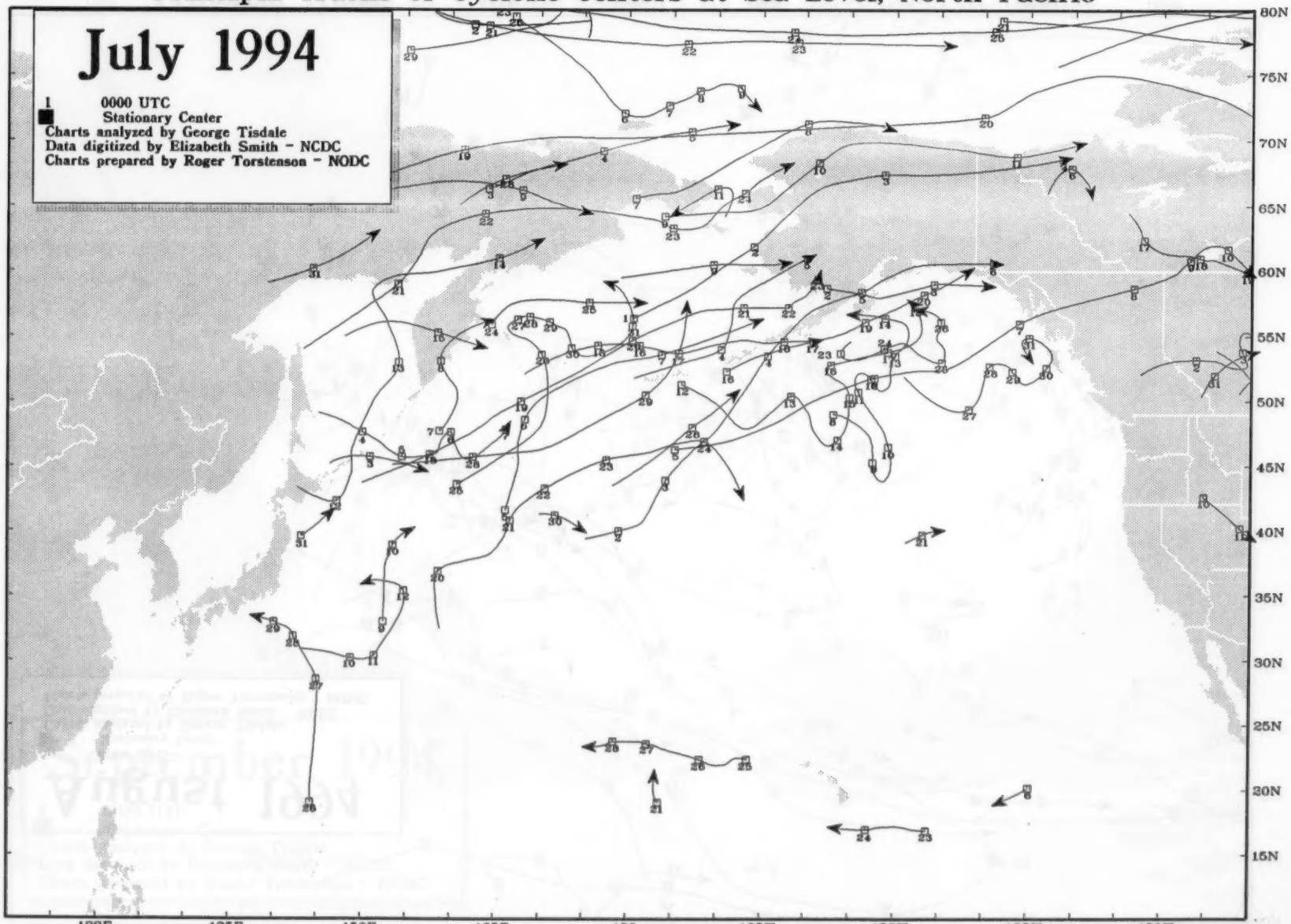


Principal Tracks of Cyclone Centers at Sea Level, North Pacific



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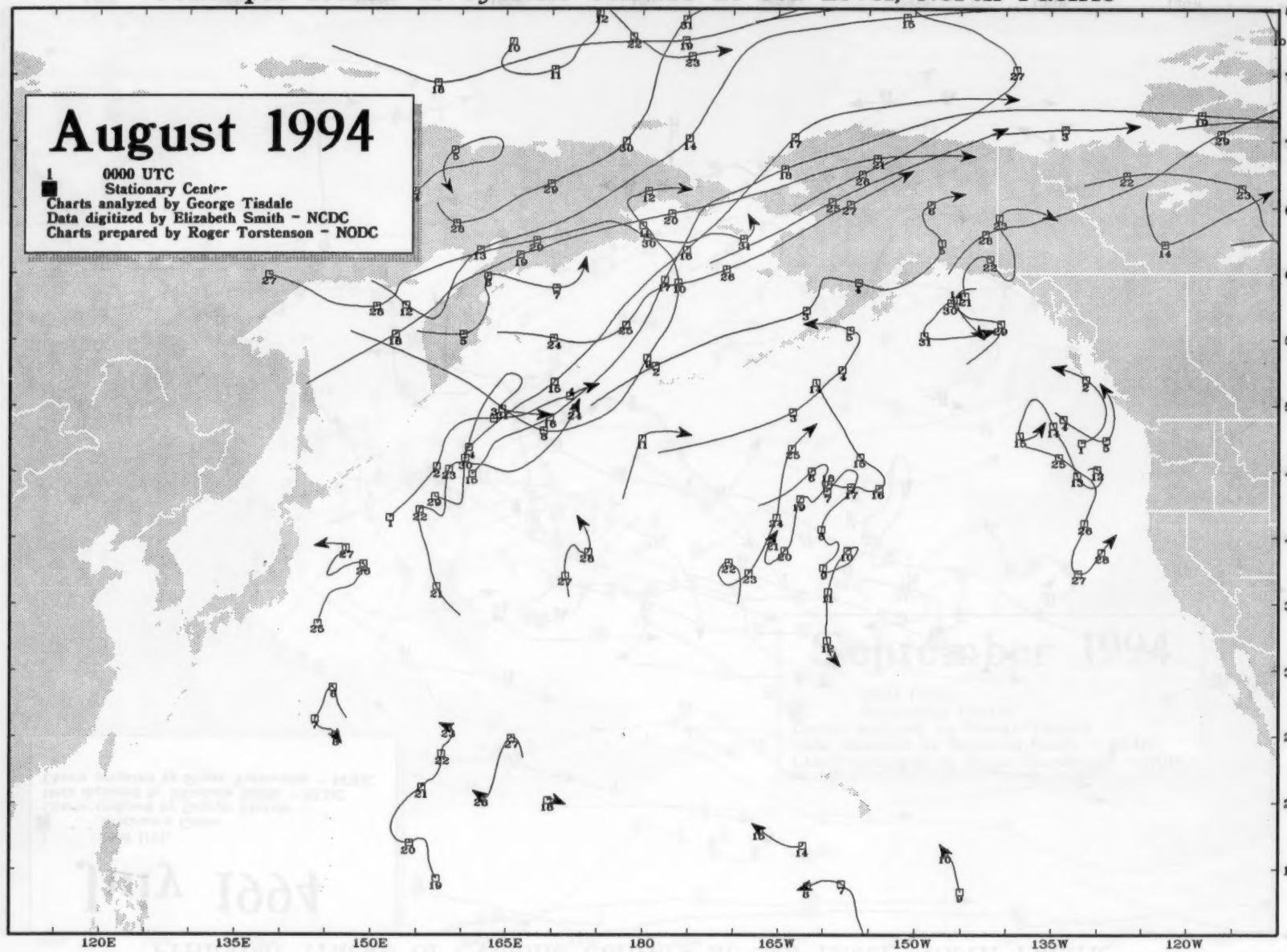

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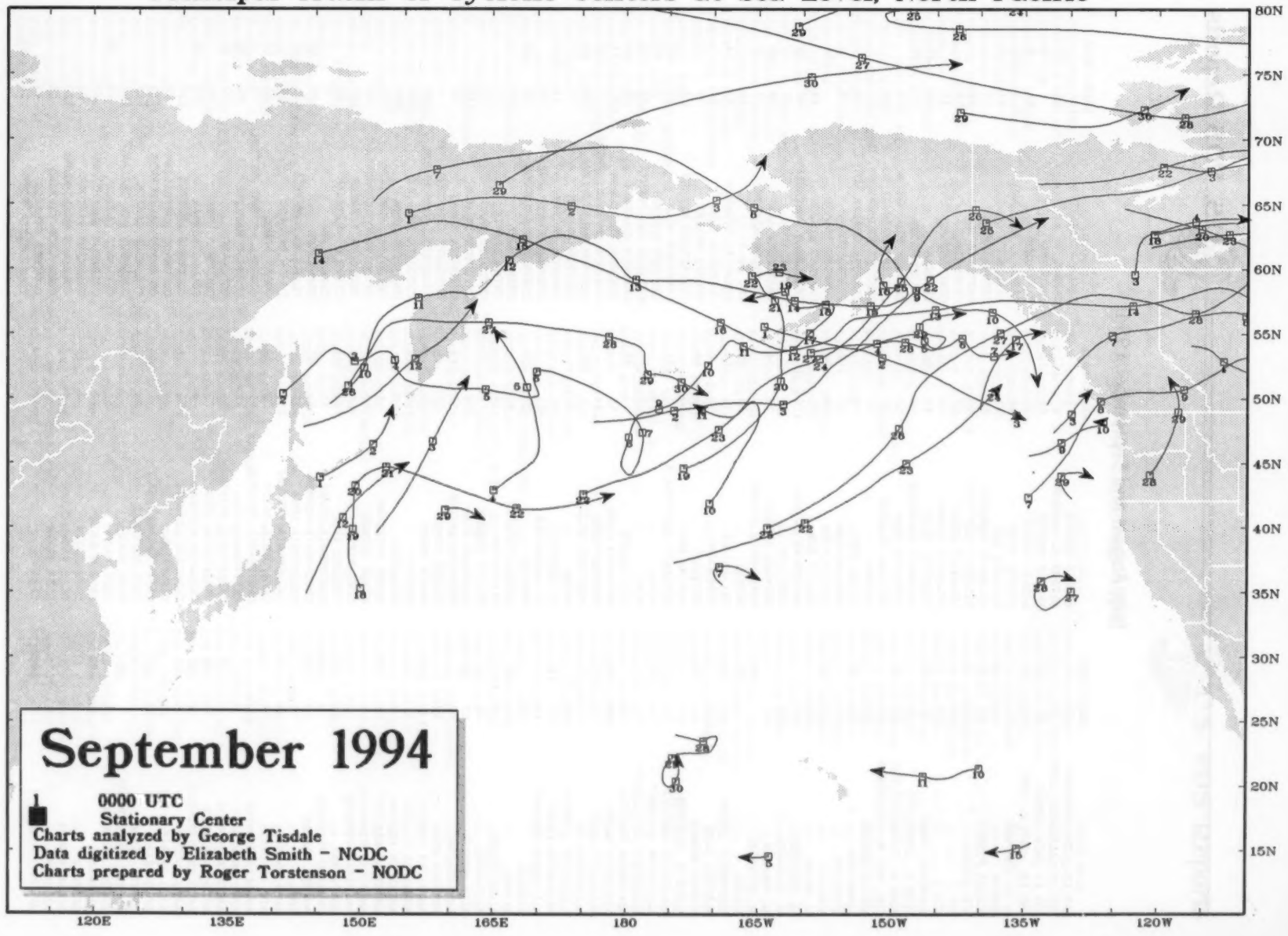

July, August and September 1994

	RADIO	MAIL
1ST LT ALEX BONNYMAN	9	12
1ST LT BALDOMERO LOPEZ	6	
1ST LT JACK LUMMUS	49	21
2ND LT. JOHN P. BOBO	2	18
A. V. KASTNER	41	
ACACIA	25	16
ACADIA FOREST	40	197
ACE ACCORD	36	12
ACT 7	154	
ACT I	119	
ADABELLE LYKES	79	147
ADAM E. CORNELIUS	8	
ADAM E. CORNELIUS,USA	18	42
ADM. WM. M. CALLAGHAN	19	
ADRIAN MAERSK	22	
ADVANTAGE	75	85
AFFINITY	11	
AGULHAS	28	54
AL AWDAH	195	
AL SAMIDOON	249	
AL SHUHADAA	228	
AL TAHREER	191	
AL WATTAYAH		86
ALASKA		84
ALBEMARLE ISLAND	42	13
ALBERNI DAWN	127	
ALBERT MAERSK	11	59
ALDEN W. CLAUSEN	49	
ALLIGATOR AMERICA	78	
ALLIGATOR COLUMBUS	52	77
ALLIGATOR EXCELLENCE	55	
ALLIGATOR FORTUNE	29	
ALLIGATOR GLORY	52	143
ALLIGATOR HOPE	38	179
ALLIGATOR JOY	32	33
ALLIGATOR LIBERTY	160	
ALLIGATOR PRIDE	107	246
ALLIGATOR TRIUMPH	48	9
ALMANIA	19	
ALPENA	169	207
ALPHA HELIX	119	135
ALTAMONTE	24	11
ALVA MAERSK	57	55
AMBASSADOR	78	
AMERICA STAR	87	
AMERICAN CONDOR	101	208
AMERICAN FALCON	51	10
AMERICAN KESTREL	8	
AMERICAN MARINER	35	44
AMERICAN REPUBLIC	1	
AMERICAN VETERAN	7	
AMERICANA	40	48
AMERIGO VESPUCCI	34	73
ANDERS MAERSK	62	164
ANNA	75	
ANNA MAERSK	84	9
APJ SHALIN	26	
ARABIAN SENATOR	322	
ARCO ANCHORAGE	8	
ARCO CALIFORNIA		49
ARCO FAIRBANKS	25	25
ARCO INDEPENDENCE	8	20
ARCO JUNEAU		35
ARCO SPIRIT	12	
ARCO TEXAS	21	25
ARCTIC OCEAN		74
ARCTIC SUN,LIBERIA		167
ARCTIC UNIVERSAL	106	
ARGONAUT	46	80
ARIES	2	
ARILD MAERSK	11	19
ARIZONA	52	219
ARMCO	165	200
ARNOLD MAERSK	30	37
ARTHUR M. ANDERSON	87	103
ARTHUR MAERSK	61	133
ASHLEY LYKES	13	
ATIGUN PASS	22	
ATLANTA BAY	57	
ATLANTIC COMPASS	65	
ATLANTIC CONVEYOR	90	
ATLANTIC HURON	25	
ATLANTIC OCEAN	29	36
ATLANTIC STAR	49	49
ATLANTIC SUPERIOR	84	
AUCKLAND STAR	12	
AUSTRAL RAINBOW	19	38
AUTHOR	77	
AVILA STAR	39	
AXEL MAERSK	67	112
B.T. ALASKA	88	198
BALTIC SUN	193	
BALTIMORE TRADER	116	152
BAR' ZAN	17	
BARBARA ANDRIE	34	94
BARRINGTON ISLAND	15	
BAUCHI	39	99
BAY BRIDGE	78	117
BEBEDOURO	73	
BELGRANO	62	54
BERGEN BAY	10	
BERNARDO QUINTANA A	72	101
BIBI	123	
BLED	37	
BLUE RIDGE	77	99
BOGASARI LIMA	50	
BONN EXPRESS	144	
BOSPORUS BRIDGE	181	309
BOVEC	82	
BP ADMIRAL	62	
BP ADVENTURE	181	
BRAVERY	20	15
BREMEN EXPRESS	41	
BRIDGETON	14	
BRIGIT MAERSK		10
BRISBANE STAR	206	
BROOKLYN BRIDGE	183	187
BROOKS RANGE	37	21
BRUCE SMART	16	
BUCKEYE	310	330
BUDAPESHT	18	
BUNGA KESIDANG	3	
BURNS HARBOR	370	419
C.W. KITTO		68
CALCITE II	122	141
CALIFORNIA CERES	93	
CALIFORNIA HERMES	76	95
CALIFORNIA LUNA	77	
CALIFORNIA MERCURY	150	
CALIFORNIA ORION	59	97
CALIFORNIA PEGASUS	61	
CALIFORNIA STAR	38	
CALIFORNIA TRITON	99	94
CALIFORNIA ZEUS	20	
CANADIAN HIGHWAY	4	
CANADIAN LIBERTY	72	16
CAP PALMAS	43	
CAPE DOMINGO,USA	1	11
CAPE HATTERAS	25	
CAPE HORN	9	10
CAPE MAY	51	
CAPE MOHICAN	20	
CAPE ROGER	1	
CAPE WASHINGTON	4	2
CAPE WRATH	54	
CARINA	43	42
CARLA A. HILLS	136	
CARMEL	21	50
CAROLINA		36
CARTAGENA	51	4
CASON J. CALLAWAY	216	228
CASSIA	43	34
CATHAY SPIRIT	10	
CATTLEYA ACE	29	
CAVENDISH	19	
CCNI ANTARTICO	42	
CEDRELA	34	27
CELEBRATION	47	49
CENTURY HIGHWAY #2	103	
CENTURY HIGHWAY NO. 5	203	
CENTURY HIGHWAY_NO. 3	93	
CENTURY LEADER NO. 1	50	
CHACABUCO	4	
CHARLES ISLAND		174
CHARLES LYKES	44	
CHARLES M. BEEGHLEY	40	35
CHARLESTON	21	
CHARLOTTE LYKES	39	148
CHASTINE MAERSK	3	12
CHC NO.1	15	
CHEMICAL PIONEER	83	34
CHEMICAL RUBI	36	
CHERRY VALLEY	6	6
CHESAPEAKE TRADER	1	
CHESTNUT HILL	23	22
CHEVRON ANTWERP	2	36
CHEVRON CALIFORNIA	139	136
CHEVRON COLORADO	78	88
CHEVRON EDINBURGH	157	121
CHEVRON EMPLOYEE PRIDE		150
CHEVRON MISSISSIPPI	39	65
CHEVRON OREGON	1	17
CHEVRON PACIFIC	11	232
CHEVRON SOUTH AMERICA	8	
CHEVRON WASHINGTON	38	26
CHINA HOPE	33	
CHINA SPIRIT	17	
CHIQUITA BARU	70	
CHIQUITA BELGIE	143	
CHIQUITA BOCAS	62	
CHIQUITA CINCINNATIAN	1	
CHIQUITA DEUTSCHLAND	205	
CHIQUITA ITALIA	170	
CHIQUITA JEAN	207	
CHIQUITA NEDERLAND	183	
CHIQUITA SCANDINAVIA	152	
CHIQUITA SCHWEIZ	149	
CIELO DI FIRENZE	53	
CLEMENTINA	5	
CLEVELAND	25	58
CLIFFORD MAERSK	125	107
CO-OP EXPRESO	24	
COAST RANGE	11	37
COASTAL CORPUS CHRISTI	2	
COASTAL MANATEE	95	96
COLORADO	39	39
COLUMBIA BAY	75	
COLUMBIA STAR	391	185
COLUMBUS AMERICA	130	
COLUMBUS AUSTRALIA	87	
COLUMBUS CALIFORNIA	139	
COLUMBUS CANADA	515	
COLUMBUS NEW ZEALAND	107	
COLUMBUS OLIVOS	24	26
COLUMBUS QUEENSLAND	123	
COLUMBUS VICTORIA	61	
COLUMBUS WELLINGTON	120	
COMPANION EXPRESS	46	
CONCERT EXPRESS	47	
CONDOLEEZZA RICE	16	83

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	RADIO	MAIL
CONTIENTAL WING	81	
CONTSHIP ENGLAND	18	
CORAH ANN	60	
CORNELIA MAERSK	112	
CORNHUSKER STATE	3	
CORNUCOPIA	15	31
CORONADO	29	23
CORPUS CHRISTI	10	
CORWITH CRAMER		18
COURIER	52	
COURTNEY BURTON	191	226
COURTNEY L.	120	211
CPL. LOUIS J. HAUGE JR	28	21
CRIMMITSCHAU	10	
CRISTOFORO COLOMBO	44	85
CROWN JEWEL		103
CROWN PRINCESS	49	
CSL ATLAS	198	
CSS HUDSON	149	
DAN MOORE	8	
DEL MONTE CONSUMER	95	67
DEL MONTE PACKER	24	
DEL MONTE TRADER	43	42
DELAWARE TRADER	58	20
DELMONTE PLANTER	10	
DELMONTE TRANSPORTER	69	70
DENALI	116	23
DIRECT EAGLE	112	87
DIRECT FALCON,BAHAMAS	103	107
DIRECT KIWI	143	92
DIRECT KOOKABURRA	73	106
DOCTOR LYKES	137	15
DOLE COSTA RICA	25	37
DOROTHEA OLDENDORFF,MO	71	40
DOUBLE GLORY	25	
DSR BALTIC	170	
DSR EUROPE	89	
DSR PACIFIC	173	
DUCHESS	2	
DUSSELDORF EXPRESS	781	
DYVI BALTIC	25	43
DYVI OCEANIC	74	
E.P. LE QUEBECOIS	689	
ECSTASY	34	32
EDELWIESS	112	49
EDGAR B. SPEER	216	235
EDINBURGH FRUID	49	
EDWIN H. GOTT	394	429
EDWIN LINK		138
EDYTH L.	52	24
EFFECTIVE,USA		18
EIBE OLDENDORFF	154	107
ELENORE		58
ELIZABETH LYKES	14	13
ELIZABETH OLDENDORFF	45	37
ELLEN HUDIG	28	
ELLEN KNUDSEN	43	
ELLENSBORG		23
ELSBORG		55
ELTON HOYT II,USA	20	26
EMMA OLDENDORFF	71	
ENDEAVOR 2	27	
ENIF	16	104
ENTERPRISE	78	
EUROPEAN SENATOR	80	
EVER GAINING	9	
EVER GENTLE	6	
EVER GIANT	10	
EVER GLAMOUR	10	
EVER GLORY	5	
EVER GLOWING	59	
EVER GOVERN	13	9
EVER GRADE	11	
EVER GROUP	7	
EVER GUARD	14	
EVER LEVEL	7	85
EVER LIVING	1	
EVER LOADING	7	
EVER RENOWN	5	
EVER ROUND	13	
EVER ROYAL	32	42
EXPORT FREEDOM	28	81
EXPORT PATRIOT	71	149
FAIRLIFT	52	
FAIRMAST	170	
FALSTRIA	47	
FANTASY	26	10
FARALLON ISLAND	367	
FARLAND	1	
FASINATION	61	57
FAUST	90	129
FEDERAL SKEENA	33	32
FERNCROFT	118	
FESTIVALE	76	74
FETISH	69	61
FIDELIO	60	3
FIESTAMARINA	94	96
FIR GROVE	53	86
FLEMMING SIF	70	69
FOREST HAWK	21	38
FORUM PRINCE		34
FRANCES HAMMER	108	
FRANCES L.	98	115
FRED R. WHITE JR	88	69
FREDERICKSBURG	71	
FREJA SVEA	5	
FRINES	30	
GALVESTON BAY	203	178
GEMINI	1	
GENEVIEVE LYKES	28	52
GEORGE A. SLOAN	132	151
GEORGE A. STINSON	114	127
GEORGE H. WEYERHAEUSER	59	
GEORGE SCHULTZ	47	42
GEORGE WASHINGTON BRID	160	
GEORGIA RAINBOW II	42	
GERONIMO	9	
GINA MARU	90	
GLOBAL LINK	75	141
GLOBAL MARINER	99	77
GLOBAL SENTINEL	31	
GOLDEN APO	32	28
GOLDEN GATE	15	38
GOLDEN GATE BRIDGE	264	82
GOPHER STATE	10	16
GREAT LAND	221	343
GREEN BAY	21	
GREEN HARBOUR	54	79
GREEN ISLAND	20	33
GREEN LAKE	75	69
GREEN MAYA	40	50
GREEN RAINIER,PANAMA	31	117
GREEN RIDGE	40	
GREEN SASEBO	46	69
GREEN SUMA	27	92
GREEN SYLVAN	32	
GREEN VALLEY	34	
GREEN WAVE	22	70
GROWTH RING	125	
GULF CURRENT	48	
GULF SPIRIT	35	
GULL ARROW	31	
GYPSUM BARON	166	
GYPSUM KING	126	
H. LEE WHITE	68	52
HANJIN BARCELONA	32	
HANJIN BREMEN	9	
HANJIN CHUNGMU	65	
HANJIN ELIZABETH	15	
HANJIN FELIXSTOWE	9	
HANJIN HAMBURG	17	
HANJIN HONG KONG	12	
HANJIN KOBE	29	
HANJIN LE HAVRE	14	
HANJIN LONG BEACH	16	
HANJIN MARSEILLES	32	
HANJIN MASAN	37	
HANJIN NEW YORK	36	
HANJIN OAKLAND	13	
HANJIN ROTTERDAM	12	
HANJIN SAVANNAH	22	
HANJIN SEATTLE	13	
HANJIN TONGHAE	35	
HANJIN VANCOUVER	14	
HANJIN YOKOHAMA	43	
HANSA LUBECK	95	
HANSA VISBY	104	
HAROLD LA BORDE	109	
HAVJO	14	19
HEIDELBERG EXPRESS	131	
HENRY HUDSON BRIDGE	159	
HERBERT C. JACKSON	146	165
HERMENIA,BAHAMAS	20	73
HERMOD	136	
HESIOD	83	
HETTSTEDT	77	
HIBISCUS	6	
HIBISCUS II		115
HOEGH CAIRN	19	35
HOEGH CLIPPER	16	
HOEGH DUKE	31	
HOEGH DYKE	10	
HOEGH MINERVA	4	
HOLIDAY	45	36
HOOD ISLAND	108	121
HOWELL LYKES	52	80
HUAL ANGELITA	18	23
HUAL INGRITA	60	32
HUAL ROLITA	13	
HUMACAO	54	85
HYUNDAI CONTINENTAL	38	
HYUNDAI DUKE	11	
HYUNDAI EMPERIOR	28	
HYUNDAI NO 102	13	
HYUNDAI PORTLAND	40	
HYUNDAI VANCOUVER	40	
INDIAN GOODWILL	12	
INDIAN OCEAN	34	23
INDIANA HARBOR	28	28
INFANTA	9	
INGER	61	25
IOWA TRADER	48	
ISLA GRAN MALVINA	21	
ISLAND PRINCESS	22	
ITB BALTIMORE	105	69
ITB GROTON	131	96
ITB JACKSONVILLE	137	123
ITB MOBILE	96	40
ITB NEW YORK	123	177
ITB PHILADELPHIA	7	
IVER EXPRESS	70	
J. DENNIS BONNEY		122
JAHRE SPIRIT	21	
JALISCO	58	30
JAMES LYKES	45	37
JAMES N. SULLIVAN		122
JAMES R. BARKER	207	224
JAPAN RAINBOW 2	68	73
JAPAN SENATOR	90	
JASMINE	236	

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	RADIO	MAIL
JEAN LYKES	60	38
JEB STUART	27	141
JEBEL ALI	34	103
JEREMIAH O'BRIEN	80	83
JOHN G. MUNSON	131	180
JOHN J. BOLAND	75	102
JOHN LYKES	78	
JOHN PURVES,USA	171	161
JOHN YOUNG		43
JOSEPH H. FRANTZ	280	329
JOSEPH L. BLOCK	87	114
JOSEPH LYKES	193	103
JUBILANT	37	
JUBILEE	23	16
JULIUS HAMMER	176	37
JUPITER DIAMOND	23	
KAHO		31
KAIMOKU	178	158
KAINALU	156	105
KAKUSHIMA	86	99
KANSAS TRADER	57	
KAREN ANDRIE	109	127
KAUAI	97	120
KAYE E. BARKER	298	306
KAZIMAH	94	
KEE LUNG	21	7
KEISHO MARU	50	
KELVIN CHALLENGE	72	
KENAI	131	103
KENNETH E. HILL	70	144
KENNETH T. DERR	103	165
KENTUCKY HIGHWAY	8	
KEYSTONE CANYON	50	61
KINSMAN ENTERPRISE	34	54
KITTANING	11	12
KNORR	46	
KOLN EXPRESS	896	
KOPER EXPRESS	7	
KURE	52	47
LA TRINITY	76	85
LAKE GUARDIAN	83	96
LASH ATLANTICO	10	12
LAWRENCE H. GIANELLA	48	
LEON	24	
LEONARD J. COWLEY	16	
LEONIA	156	
LERMA	107	
LESLIE LYKES	64	114
LETITIA LYKES	3	
LIBERTY SPIRIT	5	
LIBERTY STAR	14	2
LIBERTY SUN	16	31
LIBERTY VICTORY	16	27
LIBERTY WAVE	23	18
LIRCAY	127	
LNG AQUARIUS	3	
LNG CAPRICORN	1	
LNG LEO	19	43
LNG TAURUS	66	176
LNG VIRGO	36	58
LONDON ENTERPRISE	133	
LONDON SPIRIT	119	
LONGAVI	21	
LOUISE LYKES	62	63
LT ARGOSY	9	
LT PRAGATI	44	
LT. ODYSSEY	16	
LUCKY	36	
LUCKY BULKER	47	
LUNA MAERSK	43	101
LURLINE	85	187
MAASDAM	2	
MACKINAC BRIDGE	176	57
MADAME BUTTERFLY	15	
MADISON MAERSK	45	31
MAERSK CONSTELLATION	35	
MAGIC	61	22
MAGLEBY MAERSK	66	75
MAJ STEPHEN W PLESS MP	51	
MAJESTIC MAERSK	42	86
MANGAL DESAI	49	110
MANILA SUNRISE	37	96
MANUKAI	58	182
MAR ESMERALDA	1	
MARCHEN MAERSK	32	60
MAREN MAERSK	49	50
MARGARET LYKES	37	57
MARGRETHE MAERSK	55	52
MARIA TOPIC	14	
MARIE MAERSK	62	97
MARIF	20	33
MARINE PRINCESS	19	12
MARINE RELIANCE	79	
MARIT MAERSK		26
MARJORIE LYKES	5	
MATHILDE MAERSK	6	85
MATSONIA	138	173
MAUI	173	196
MAURICE EWING	44	83
MAYAGUEZ	94	24
MAYVIEW MAERSK	66	80
MC-KINNEY MAERSK	67	95
MEDALLION	53	18
MEDUSA CHALLENGER	365	437
MELBOURNE STAR	130	
MELVILLE	86	
MERCANDIAN CONTINENT	29	
MERCHANT PREMIER	117	
MERCHANT PRINCE	97	
MERCHANT PRINCIPAL	173	
MERCURY ACE	114	
MERCURY DIAMOND	166	
MERIDA	29	47
MESABI MINER	219	237
METTE MAERSK		98
MICHIGAN	252	354
MICHIGAN HIGHWAY	46	
MICRONESIAN PRIDE	125	
MIDDLETOWN	109	163
MINERAL OSPREY	71	78
MINERVA	10	
MING PLEASURE	57	
MING PLENTY	16	35
MOANA PACIFIC	62	
MOKU PAHU	137	202
MONTERREY	90	58
MORELOS	119	141
MORMACSKY	14	
MORMACSTAR	59	51
MORMACSUN	29	38
MOTOVSKY ZALIV	18	
MT. CABRITE	46	
MYRON C. TAYLOR	124	107
MYSTIC	21	
NACIONAL VITORIA	66	
NAPIER STAR	27	
NARA	117	53
NATIONAL DIGNITY	23	10
NATIONAL HONOR	27	39
NATIONAL PRIDE	31	150
NEDLLOYD HOLLAND	96	
NEDLLOYD MARSEILLS	1	
NEDLLOYD ROTTERDAM	104	
NEDLLOYD VAN CLOON	96	
NEDLLOYD VAN DIEMEN	44	
NEDLLOYD VAN LINSCHOTE	95	
NEDLLOYD VAN NECK	117	
NEDLLOYD VAN NOORT	120	
NEDLLOYS MAURITIUS	52	
NEPTUNE AMBER	46	
NEPTUNE CORAL	18	
NEPTUNE CRYSTAL	61	
NEPTUNE DIAMOND	95	
NEPTUNE GARNET	80	
NEPTUNE JADE	36	
NEPTUNE PEARL	34	
NEVA		13
NEW CARISSA	59	224
NEW HORIZON	17	
NEWARK BAY	63	19
NIEUW AMSTERDAM	6	
NIPPON HIGHWAY	7	
NOAA DAVID STARR JORDA	42	24
NOAA SHIP ALBATROSS IV	187	207
NOAA SHIP CHAPMAN	187	253
NOAA SHIP DELAWARE II	320	340
NOAA SHIP DISCOVERER O	315	327
NOAA SHIP FERREL	188	224
NOAA SHIP M. BALDRIDGE	502	221
NOAA SHIP MCARTHUR	200	157
NOAA SHIP MILLER FREEM	510	638
NOAA SHIP MT MITCHELL	425	503
NOAA SHIP OREGON II	461	370
NOAA SHIP RAINIER	211	251
NOAA SHIP SURVEYOR	320	426
NOAA SHIP T. CROMWELL	113	
NOAA SHIP WHITING	271	304
NOBEL STAR	70	
NOMADIC MERMAID	27	
NORD JAHRE TARGET	126	
NORTHERN LIGHTS	205	245
NORTHERN LION	181	
NORWAY	113	207
NOSAC EXPLORER	8	
NOSAC EXPRESS	4	
NOSAC RANGER	98	
NOSAC STAR	27	
NOSAC TAKAYAMA	137	57
NUEVO LEON	68	12
NUEVO SAN JUAN	69	20
NURNBERG ATLANTIC	670	
NYK SEABREEZE	64	
NYK SPRINGTIDE	159	
NYK STARLIGHT	63	
NYK SUNRISE	80	
NYK SURFWIND	30	
OAXACA	124	
OBO ENGIN	45	
OCEAN EXPLORER	171	
OCEAN HIGHWAY	53	
OCEAN LEADER	111	
OCEAN OPAL	15	45
OCEAN SPIRIT	176	
OCEANUS OSAKA	113	94
ODELIA	25	18
OLEANDER,DUTCH ANTILLE	154	89
OLIVE ACE	18	
OLIVEBANK	47	
OMI MISSOURI	84	100
OOCL BRAVERY	73	
OOCL EDUCATOR	83	77
OOCL ENVOY	80	
OOCL EXECUTIVE	98	17
OOCL EXPLORER	47	51
OOCL EXPORTER	90	
OOCL FAIR	103	
OOCL FAITH	74	
OOCL FAME	79	
OOCL FIDELITY	116	

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	RADIO	MAIL
OOCL FORTUNE	137	47
OOCL FREEDOM	162	
OOCL FRIENDSHIP	112	
OOCL FRONTIER,HONG KON	59	31
OOCL INNOVATION	77	111
OOCL INSPIRATION	60	67
ORANGE BLOSSOM	35	24
ORANGE STAR	3	39
ORION HIGHWAY	110	
OURO DO BRASIL	65	
OVERSEAS ALASKA	35	33
OVERSEAS ARCTIC	22	20
OVERSEAS CHICAGO	14	
OVERSEAS HARRIET	29	11
OVERSEAS JOYCE	52	
OVERSEAS MARILYN	23	
OVERSEAS NEW ORLEANS	64	
OVERSEAS OHIO	14	34
PACDUKE	31	
PACIFIC EMERALD	41	24
PACKING	18	
PACMERCHANT	29	
PACPRINCE	37	
PACPRINCESS	27	
PACSTAR	5	
PACSUN	48	30
PADRONE	71	
PALMGRACHT	60	
PAPAGO	72	77
PARIS SENATOR	18	
PATRIOT	22	
PAUL BUCK	47	
PAUL H. TOWNSEND	133	116
PAUL R. TREGURTHA	335	362
PAUL THAYER	17	32
PECOS	1	
PEMBINA	75	
PERMEKE,LIBERIA	18	37
PETER W. ANDERSON	31	
PETROBULK PROGRESS	9	
PETROBULK RACER		91
PFC EUGENE A. OBREGON	2	
PFC JAMES ANDERSON JR	19	36
PFC WILLIAM B. BAUGH	20	39
PHAROS	96	
PHILIP R. CLARKE	92	99
PHOENIX DIAMOND	31	
PISCES PIONEER	132	
PISCES PLANTER	159	
PLATTE	29	65
POLAR EAGLE,LIBERIA	22	134
POLYNESIA	14	
POOLGRACHT	131	
POTOMAC	3	
POTOMAC TRADER	11	
PRESIDENT ADAMS	63	93
PRESIDENT ARTHUR	22	43
PRESIDENT BUCHANAN	22	24
PRESIDENT EISENHOWER	3	75
PRESIDENT F. ROOSEVELT	217	133
PRESIDENT GARFIELD	27	50
PRESIDENT GRANT	62	85
PRESIDENT HARDING	95	120
PRESIDENT HARRISON	61	
PRESIDENT HOOVER	21	149
PRESIDENT JACKSON	23	132
PRESIDENT JEFFERSON	51	72
PRESIDENT KENNEDY	99	137
PRESIDENT LINCOLN	96	212
PRESIDENT MONROE	137	212
PRESIDENT POLK	109	127
PRESIDENT TRUMAN	74	44
PRESIDENT TYLER	63	218
PRESIDENT WASHINGTON	32	21
PRESQUE ISLE	134	195
PRIDE OF BALTIMORE	44	24
PRINCE OF OCEAN	104	235
PRINCE OF TOKYO	55	64
PRINCE OF TOKYO 2	110	126
PRINCE WILLIAM SOUND	49	45
PROJECT ORIENT	104	
PROOF GALLANT		73
PUERTO CORTES	120	
PVT FRANKLIN J. PHILLI	5	15
PYTCHLEY	192	
QUALITY OF LIFE	3	
QUEEN ELIZABETH 2	170	
QUEENSLAND STAR	247	
R. HAL DEAN	40	
R.J. PFEIFFER	99	53
RAINBOW WARRIOR	103	
RALEIGH BAY	26	35
RANI PADMINI	80	
RECIFE	25	
REGAL EMPRESS	13	6
REGINA J	11	
REPULSE BAY	160	
RESERVE	123	138
RESOLUTE	48	111
RHINE FOREST	104	133
RICHARD G MATTIESEN	44	
RICHARD REISS	81	47
ROBERT E. LEE	16	35
ROGER BLOUGH	123	101
ROSINA TOPIC	3	
ROTTERDAM	1	
ROVER	43	
ROWANBANK	88	
ROYAL PRINCESS	57	
RUBIN DOGA	14	15
RUBIN OCEAN	31	13
RUTH LYKES	30	
S.T. CRAPO	149	175
SALINAS	16	22
SALOME	94	220
SAM HOUSTON	32	32
SAMUAL GINN	51	64
SAMUEL H. ARMACOST	108	67
SAMUEL L. COBB	61	
SAMUEL RISLEY	508	
SAN ISIDRO	107	
SAN LORENZO	2	
SAN MARCOS	159	
SAN PEDRO	37	
SAN VINCENTE	28	
SANTA MONICA	70	
SANTA PAULA	149	170
SANTORIN 2		252
SAPAI	91	
SAVANNAH	49	
SCARAB	30	
SEA BELLS	18	31
SEA COMMERCE	113	104
SEA FORTUNE	35	132
SEA FOX	136	66
SEA ISLE CITY	35	
SEA LIGHT	33	19
SEA LION	343	102
SEA MERCHANT	1	
SEA PRINCESS	15	20
SEA SPRAY	6	
SEA TRADE	55	48
SEA WOLF	125	37
SEA-LAND SHINING STAR	245	245
SEABOARD OCEAN	63	261
SEABOARD SUN	51	19
SEABOARD UNIVERSE	32	38
SEACON	40	74
SEALAND ANCHORAGE	81	119
SEALAND ATLANTIC	133	68
SEALAND CHALLENGER	96	63
SEALAND CONSUMER	196	120
SEALAND COSTA RICA	129	159
SEALAND CRUSADER	33	
SEALAND DEFENDER	39	41
SEALAND DEVELOPER	69	136
SEALAND DISCOVERY	46	38
SEALAND ENDURANCE	72	105
SEALAND ENTERPRISE	41	149
SEALAND EXPEDITION	48	34
SEALAND EXPLORER	82	110
SEALAND EXPRESS	181	198
SEALAND HAWAII	200	195
SEALAND INDEPENDENCE	42	104
SEALAND INNOVATOR	75	23
SEALAND INTEGRITY	204	
SEALAND KODIAK	50	124
SEALAND LIBERATOR	62	148
SEALAND MARINER	77	98
SEALAND NAVIGATOR	229	235
SEALAND PACIFIC	203	218
SEALAND PATRIOT	67	37
SEALAND PERFORMANCE	50	64
SEALAND PRODUCER	93	103
SEALAND QUALITY	60	65
SEALAND RELIANCE	88	162
SEALAND SPIRIT	103	224
SEALAND TACOMA	47	124
SEALAND TRADER	198	220
SEALAND VOYAGER	79	42
SEARIVER BATON ROUGE	20	28
SEARIVER BENICIA	8	10
SEARIVER CHARLESTOWN	1	
SEARIVER LONG BEACH	14	7
SEARIVER MEDITERRANEAN	27	12
SEARIVER NORTH SLOPE	7	9
SEARIVER PHILADELPHIA	17	29
SEAWARD JOHNSON	5	15
SEDCO/BP 471	67	179
SEMINOLE		23
SENATOR	103	32
SENORITA	1	144
SENSATION	5	45
SERAFIN TOPIC	53	
SETO BRIDGE,JAPAN	196	19
SEVEN OCEAN	30	
SGT WILLIAM A BUTTON	1	
SGT. METEJ KOCAK	5	
SHELDON LYKES	49	43
SHELLY BAY	101	110
SHIRAOI MARU	139	39
SIDNEY STAR	130	
SINBAD	7	
SINCERE SUCCESS	28	30
SKAUBRYN	125	
SKAUGRAN	148	
SKOGAFOSS	95	
SN	364	
SOKOLICA	22	
SOLAR WING	125	120
SONG OF AMERICA	20	
SOREN TOUBRO	8	
SOUTHERN PRINCESS		137
ST BLAIZE	30	
ST. LUCIA	34	
STAFFORDSHIRE	232	
STAR ALABAMA	34	
STAR AMERICA	74	75
STAR DAVANGER	18	
STAR DOVER	39	

July, August and September 1994

	RADIO	MAIL
STAR DRIVANGER	112	
STAR DROTTANGER	74	
STAR EAGLE	100	
STAR EVVIVA	49	54
STAR FLORIDA	111	36
STAR FRASER	56	36
STAR FUJI	76	
STAR GEIRANGER	13	
STAR GRAN	31	28
STAR SKARVEN	31	30
STAR SKOGANGER	15	31
STAR STRONEN	28	
STARSHIP MAJESTIC	6	26
STATE OF GUIARAT	55	
STELLA LYKES	30	1
STELLAR BENY	120	22
STELLAR VENUS	45	
STEWART J. CORT	340	386
STOLT CONDOR	23	
STONEWALL JACKSON	16	53
STRONG VIRGINIAN	54	24
SUE LYKES	9	
SUGAR ISLANDER	47	56
SUN VIKING	29	46
SUNBELT DIXIE	74	
SUNRISE RUBY	51	47
SWAN ARROW	2	
SYNNOVE KNUSTEN	40	37
T.S.EMPIRE STATE	32	
TAI CHUNG	25	
TAI HE	162	
TAI SHING	61	45
TAMAMONTA	29	
TAMATHAI	1	
TAMPA	32	
TAMPA BAY	41	
TEAL ARROW	41	75
TEXAS CLIPPER	28	
THOMAS G. THOMPSON	60	125
THOMPSON LYKES	46	61
THOMPSON PASS		1
TILLIE LYKES	28	33
TOHZAN	21	45
TOKYO HIGHWAY	8	
TOKYO SENATOR	136	
TOLUCA	78	43
TONSINA	21	10
TORM FREYA	82	38
TOWER BRIDGE	45	
TRANSWORLD BRIDGE	138	81
TRITON	180	275
TROPIC DAY	7	99
TROPIC FLYER	3	151
TROPIC ISLE	3	
TROPIC JADE	18	97
TROPIC LURE	6	91
TROPIC MIST		75
TROPIC OPAL		38
TROPIC PALM		71
TROPIC SUN	248	269
TROPIC TIDE	54	111
TSL BOLD		78
TULSIDAS	41	
TUSTUMENA	11	
TYSON LYKES	27	
UCHOA	68	140
ULLSWATER	107	
ULTRAMAX	13	65
ULTRASEA	50	60
UNIVERSE	21	
USCGC ACACIA (WLB406)	30	
USCGC ACTIVE WMEC 618	12	
USCGC ACUSHNET WMEC 16	123	
USCGC BEAR (WEMC 901)	12	
USCGC BRAMBLE (WLB 392	3	
USCGC CAMPBELL	61	
USCGC CHASE (WHEC 718)	33	
USCGC CONFIDENCE WMEC6	36	
USCGC COURAGEOUS	5	
USCGC DALLAS (WHEC 716	1	
USCGC DECISIVE WMEC 62	7	
USCGC DEPENDABLE	43	
USCGC DILIGENCE WMEC 6	2	
USCGC DURABLE (WMEC 62	52	
USCGC EAGLE (WIX 327)	17	
USCGC ESCANABA	57	
USCGC FIREBUSH WLB 393	22	
USCGC FORWARD	53	
USCGC GALLATIN	59	71
USCGC HAMILTON WHEC 71	29	
USCGC HARRIET LANE	10	
USCGC IRONWOOD (WLB 29	7	
USCGC JARVIS (WHEC 725	93	
USCGC MACKINAW	2	
USCGC MALLOW (WLB 396)	84	
USCGC MARIPOSA	1	
USCGC MELLON (WHEC 717	82	34
USCGC MIDGETT (WHEC 72	77	
USCGC MOHAWK WMEC 913	8	
USCGC MORGENTHAU	6	
USCGC MUNRO	85	44
USCGC NORTHLAND WMEC 9	51	72
USCGC POLAR SEA__(WAGB	195	
USCGC POLAR STAR (WAGB	37	58
USCGC RELIANCE WMEC 61	17	
USCGC RUSH	97	
USCGC SASSAFRAS	28	
USCGC SEDGE (WLB 402)	1	
USCGC SENECA	27	
USCGC SHERMAN		15
USCGC SPENCER	59	64
USCGC STEADFAST (WMEC	28	40
USCGC STORIS (WMEC 38)	155	177
USCGC SUNDEW (WLB 404)	13	
USCGC SWEETBRIER WLB 4	1	
USCGC TAHOMA	33	
USCGC TAMPA WMEC 902	24	14
USCGC THETIS		23
USCGC VALIANT (WMEC 62	15	47
USCGC VIGILANT WMEC 61	30	
USCGC VIGOROUS WMEC 62	46	60
USCGC WOODRUSH (WLB 40	1	
USCGC YOCONA (WMEC 168	84	127
USNS ALGOL	1	
USNS ANTARES	8	
USNS APACHE (T-ATF 172	35	74
USNS BELLATRIX	3	
USNS CATAWBA T-ATF 168	75	75
USNS COMFORT	1	
USNS CONCORD		23
USNS GUS W. DARNELL	44	
USNS HAYES	32	
USNS JOHN MCDONNELL (T	192	279
USNS LEROY GRUMMAN		32
USNS LITTLEHALES (T-AG	16	
USNS NARRAGANSETT	58	67
USNS NAVAJO_(TATF-169)	56	
USNS PECOS	22	
USNS POWHATAN TATF 166	130	137
USNS REGULUS	8	
USNS SAN DIEGO	56	19
USNS SEALIFT ANTARCTIC	51	
USNS SEALIFT ARABIAN S	71	
USNS SEALIFT ARCTIC	97	55
USNS SEALIFT ATLANTIC	124	157
USNS SEALIFT CARIBBEAN	101	49
USNS SEALIFT CHINA SEA	71	56
USNS SEALIFT INDIAN OC	32	31
USNS SEALIFT MEDITERRA	77	
USNS SEALIFT PACIFIC	8	
USNS SILAS BENT T-AGS	44	
USNS VANGUARD TAG 194	36	
USNS WALTER S. DIEHL		133
USNS WILKES T-AGS-33	70	28
USNS YUKON (T-AO 202)	12	
VENUS DIAMOND	127	
VERA ACORDE	20	63
VINA DEL MAR	102	
VINE	228	
VIRGINIA	34	72
VISHVA SHAKTI	4	
VISHVA VIKRAM	1	
VIVA	52	
VOROSMARTY		21
WALTER J. MCCARTHY	23	28
WASHINGTON HIGHWAY	129	
WEST MOOR	257	
WESTERN LION	3	
WESTWARD VENTURE	48	76
WESTWOOD ANETTE	136	147
WESTWOOD BELINDA	26	
WESTWOOD CLEO	101	37
WESTWOOD JAGO	95	148
WESTWOOD MARIANNE	33	39
WILFRED SYKES	133	160
WILLIAM E. CRAIN		49
WILLIAM E. MUSSMAN	25	4
WILLIAM R. ROESCH	6	27
WOLVERINE	7	3
YOUNG SATO	29	
YOUNG SPROUT	84	69
YUCATAN	20	
ZAGREB EXPRESS	16	
ZETLAND	155	
ZIM AMERICA	33	
ZIM CANADA	77	
ZIM HOUSTON	3	
ZIM IBERIA	39	
ZIM JAPAN	106	
ZIM KEELUNG	76	
ZIM MIAMI	50	
ZIM SAVANNAH	94	

SUMMARY: GRAND TOTAL VIA RADIO 74408

GRAND TOTAL VIA MAIL 48520

TOTAL UNIQUE OBS 95158

TOTAL DUPLICATES 27770 (29.2%)

UNIQUE RADIO OBS.46638 (49.0%)

UNIQUE MAIL OBS. 20750 (21.8%)

Wave observations are taken each hour during a 20–minute averaging period, with a sample taken every 0.67 seconds. The significant wave height is defined as the average height of the highest one–third of the waves during the average period each hour. The maximum significant wave height is the highest of those values for that month. At most stations, air temperature, water temperature, wind speed and direction are sampled once per second during an 8.0–minute averaging period each hour (moored buoys) and a 2.0–minute averaging period for fixed stations (C–MAN). Contact NDBC Data Systems Division, Bldg 1100, SSC, Mississippi 39529 or phone (601) 688–2838 for more details.

July, August and September 1994

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
JULY		1994											
32302	18.0S	085.1W	0736	18.0	19.3	2.4	4.4	31/00	13.5	SE	20.0	01/16	1016.8
41001	34.7N	072.7W	0739	26.9	27.2	1.3	2.6	27/22	11.1	SW	20.6	27/04	1020.1
41002	32.3N	075.2W	0739	27.1	27.5	1.1	2.2	27/08	11.2	S	23.5	23/20	1020.3
41004	32.5N	079.1W	0740	26.9	27.5	1.0	2.4	20/20	11.9	S	26.2	20/18	1019.2
41006	29.3N	077.3W	0738	27.6	28.6	0.9	2.0	02/21	9.1	S	20.6	18/16	1020.0
41009	28.5N	080.2W	1476	27.2	27.6	0.5	1.3	03/02	8.1	SE	26.4	28/22	1019.2
41010	28.9N	078.5W	1483	27.7	28.7	0.9	1.7	02/15	8.5	SE	20.6	02/16	1019.9
41016	24.6N	076.5W	0738	27.9	28.9	0.6	1.3	02/12	12.2	E	19.8	01/09	1020.1
41021	31.9N	080.9W	0740	26.6	27.8	0.3	0.9	01/01	10.5	S	22.2	27/20	1017.8
42001	25.9N	089.7W	0740	28.3	29.1	0.6	2.0	02/09	8.2	SE	20.6	30/14	1018.1
42002	25.9N	093.6W	0739	28.9	29.7	0.8	1.8	05/07	10.5	SE	23.3	31/23	1016.2
42003	25.9N	085.9W	0733		29.2	0.8	4.2	02/18	8.0	S	17.9	30/18	1018.6
42007	30.1N	088.8W	0739	27.3	28.5				10.2	SW	35.0	27/15	1017.1
42019	27.9N	095.0W	0719	28.5	29.0	0.9	2.0	14/11	10.6	E	24.1	31/12	1015.4
42020	27.0N	096.5W	0734	28.5	28.3	1.0	2.1	14/08	12.4	SE	20.8	14/06	1014.9
42035	29.3N	094.4W	0736	28.4	29.0	0.8	1.7	14/07	10.7	S	23.1	31/16	1015.9
42036	28.5N	084.5W	0735	28.3	28.4	0.7	3.7	03/04	7.6	SE	28.8	03/03	1018.8
42037	24.5N	081.4W	0738	28.2	28.8	0.7	1.4	04/09	9.1	E	17.3	10/17	1018.3
44004	38.5N	070.7W	0453	26.3	26.3	1.2	2.9	28/12	10.0	SW	21.4	28/10	1018.4
44005	42.9N	069.0W	0739	19.8	19.1	0.9	2.3	22/22	10.6	S	22.2	29/01	1016.3
44007	43.5N	070.2W	0741	17.8	16.4	0.6	1.5	06/00	7.0	S	20.4	06/03	1015.0
44008	40.5N	069.4W	0732	22.1	19.4	0.9	2.4	28/19	7.3	S	16.1	28/11	1017.5
44009	38.5N	074.7W	0734	22.6	21.7	0.8	1.9	28/13	8.4	S	21.0	23/17	1017.4
44011	41.1N	066.6W	0740	20.0	18.3	1.0	2.9	01/04	7.3	S	17.3	29/03	1017.8
44013	42.4N	070.7W	0736	20.0	18.3	0.3	0.9	20/00					1015.9
44014	36.6N	074.8W	0738	25.7		0.8	2.3	28/06	10.7	S	27.0	23/18	1018.7
44025	40.3N	073.2W	0737	23.3	22.8	0.8	2.6	28/15	9.6	SW	22.2	29/00	1016.2
44028	41.4N	071.0W	0429	21.6	20.3	0.8	1.9	29/02	10.7	SW	20.4	22/14	1016.7
45001	48.1N	087.8W	0730	7.2	4.6	0.3	1.1	12/22	7.6	SW	22.3	01/05	1012.7
45002	45.3N	086.4W	0732	15.8	14.7	0.5	2.3	12/00	8.9	S	23.3	11/22	1013.3
45003	45.3N	082.8W	0477	15.2	13.9	0.3	1.2	21/06	7.5	S	20.6	21/04	1013.3
45004	47.6N	086.5W	0738	6.2	3.6	0.3	1.4	04/21	7.5	SE	21.0	04/19	1013.7
45005	41.7N	082.4W	0741	22.6	23.0	0.4	1.0	09/11	9.0	SW	20.4	09/02	1015.0
45006	47.3N	089.9W	0743	11.0	7.9	0.4	1.3	12/12	6.6	W	17.0	17/04	1012.6
45007	42.8N	087.1W	0730	18.8	18.1	0.4	1.5	02/18	8.5	S	17.9	08/09	1014.6
45008	44.3N	082.4W	0742	16.6	15.0	0.4	1.5	10/10	7.0	S	20.2	21/03	1014.5
45010	43.0N	087.8W	0738	18.7	17.5	0.3	1.6	13/12	8.6	S	22.9	02/18	1014.1
46001	56.3N	148.2W	0733	11.2	11.2	1.6	3.6	21/23	12.2	SW	22.7	21/18	1015.4
46002	42.5N	130.3W	0733	15.1	15.9	1.7	2.7	05/06	12.1	N	21.4	05/01	1022.6
46003	51.9N	155.9W	0739	9.4	9.4	1.7	4.8	17/11	10.7	W	25.3	16/07	1014.2
46005	46.1N	131.0W	0728	14.2	14.6	1.5	2.6	19/06	10.7	N	20.4	05/01	1023.1
46006	40.9N	137.5W	0734	16.0	16.9	1.4	2.6	19/00	8.0	NE	16.1	04/17	1026.2
46012	37.4N	122.7W	0387	11.5		1.6	2.7	04/08	7.2	NW	15.5	02/04	1014.9
46013	38.2N	123.3W	0719	11.3	10.7	1.9	3.6	15/07	11.3	N	30.1	30/03	1013.3
46014	39.2N	124.0W	0728	11.5	11.0	2.3	4.8	15/03	12.7	NW	27.4	05/02	1015.2
46022	40.8N	124.5W	0731	11.8	11.2	2.2	4.1	15/09	11.8	N	24.7	04/08	1016.3
46023	34.3N	120.7W	0740	13.8	14.5	1.7	3.0	28/06	13.9	NW	25.0	02/22	1015.4
46025	33.8N	119.1W	0683	17.1	19.2	0.8	1.6	04/04	5.9	W	15.7	23/01	1013.2
46026	37.8N	122.8W	0735		12.0	1.4	2.7	02/04	7.9	NW	20.2	02/09	1015.0
46027	41.9N	124.4W	0733	11.0	10.0	2.0	3.7	14/23	10.5	N	34.0	15/00	1015.6
46028	35.8N	121.9W	0737	13.0	13.0	1.7	3.3	01/04	9.6	NW	26.8	01/01	1015.8
46029	46.2N	124.2W	0737	14.6	12.5	1.5	3.1	05/09	9.1	N	22.0	07/21	1019.9
46035	57.0N	177.7W	0721	7.0	7.1	1.3	3.7	16/00	11.7	SW	27.2	16/00	1008.8
46041	47.4N	124.5W	0735	12.7	12.4	1.3	2.8	05/03	7.4	NW	18.7	17/02	1019.3
46042	36.8N	122.4W	0730	12.7	13.2	1.5	3.0	06/01	8.8	NW	21.4	27/00	1014.4
46045	33.8N	118.5W	0731	17.5	18.8	0.8	1.5	24/02	5.8	W	13.4	03/22	1013.9
46050	44.6N	124.5W	0729	13.2		1.6	3.3	05/14	11.8	N	23.5	08/00	1018.3
46051	34.5N	120.7W	0729	13.2	13.5				13.5	SE	25.1	27/07	1015.4
46053	34.2N	119.9W	0736	15.0	16.4	0.9	2.1	04/01	10.6	W	22.9	22/01	1013.8
46054	34.3N	120.5W	0729	13.5	14.5	1.5	2.7	02/02	17.9	NW	31.9	02/23	1014.9
51001	23.4N	162.3W	0479	27.1	26.3	1.5	2.2	12/06	15.1	E	22.0	24/02	1017.0
51002	17.2N	157.8W	0740	26.3	26.4	2.5	8.6	22/08	17.5	E	47.2	22/07	1013.1
51003	19.1N	160.8W	0743	26.2	26.8	2.1	5.2	23/08	12.9	E	29.1	23/07	1013.5
51004	17.4N	152.5W	0741	26.0	26.6	2.3	4.0	26/03	16.6	NE	25.1	20/20	1014.5
51026	21.4N	157.0W	0413	24.9	25.3				16.4	E	21.4	12/21	1016.0
91222	18.1N	145.8E	0659	28.3					5.5	E	20.7	29/14	1007.7
91251	11.4N	162.4E	0678	27.9					10.6	NW	23.3	28/15	1008.6
91328	8.6N	149.7E	0676	27.5					6.0	SW	28.5	25/11	1009.4
91338	5.3N	153.7E	0691	27.6					5.5	SW	26.3	12/01	1008.1
91343	7.6N	155.2E	0634	27.6					4.6	NE	22.6	02/08	1008.1
91352	6.2N	160.7E	0231	27.5					3.0	N	11.0	20/17	1009.0
91355	5.4N	163.0E	0688	26.9					5.6	E	23.3	18/02	1007.9
91377	6.1N	172.1E	0699	27.8					6.3	NE	21.3	13/13	1010.3

July, August and September 1994

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
ABAN6	44.3N	075.9W	0738	21.5	19.7				3.1	S	13.0	05/14	1016.0
ALSN6	40.5N	073.8W	0740	23.1	21.8	0.7	1.8	22/18	11.7	S	29.9	22/23	1016.5
BURL1	28.9N	089.4W	0720	27.7					9.1	SW	30.5	22/13	1017.5
CARO3	43.3N	124.4W	0725	11.4					8.3	N	22.0	19/22	1018.7
CHLV2	36.9N	075.7W	0600	24.4	23.0	0.5	1.0	01/08	12.0	SW	25.3	28/20	1017.5
CLKN7	34.6N	076.5W	0735	26.8					10.9	SW	27.2	22/12	1019.5
CSBF1	29.7N	085.4W	0732	27.3					8.1	SW	26.9	03/16	1018.3
DBLN6	42.5N	079.4W	0736	21.7					7.9	SW	33.1	13/02	1016.4
DESW1	47.7N	124.5W	0724	12.7					8.7	NW	24.0	08/01	1019.3
DISW3	47.1N	090.7W	0741	15.8					9.1	SW	23.8	12/10	1013.2
DPIA1	30.3N	088.1W	0729	26.9	28.7				8.6	SW	24.1	13/20	1017.8
DRYF1	24.6N	082.9W	0732	28.5					9.7	E	20.4	02/07	1018.3
DSLN7	35.2N	075.3W	0740	26.4	26.3				15.5	SW	38.9	23/16	1019.6
FBIS1	32.7N	079.9W	0737	27.3					9.9	SW	23.3	27/21	1018.7
FFIA2	57.3N	133.6W	0735	12.9					6.7	S	20.2	19/17	1018.2
FPSN7	33.5N	077.6W	0738	26.6		1.1	2.5	19/23	14.4	S	33.1	28/03	1019.0
FWYF1	25.6N	080.1W	0216	28.6	29.4				9.6	SE	27.1	28/09	1018.2
GDIL1	29.3N	090.0W	0732	27.6	29.8				7.2	S	22.0	19/01	1017.7
GLLN6	43.9N	076.5W	0738	20.6					9.4	S	27.4	10/18	1014.3
IOSN3	43.0N	070.6W	0738	20.4					11.6	S	27.6	06/01	1015.4
LKWF1	26.6N	080.0W	0736	27.8	28.6				9.0	SE	20.1	19/09	1019.8
LONF1	24.9N	080.9W	0735	28.4	30.2				10.2	E	24.5	29/05	1018.6
MDRM1	44.0N	068.1W	0739	16.1					13.0	S	25.0	22/21	1015.8
MISM1	43.8N	068.9W	0739	16.5					12.8	SW	27.0	06/05	1015.7
MLRF1	25.0N	080.4W	0739	28.2	29.1				10.0	SE	28.5	29/05	1018.2
NWPO3	44.6N	124.1W	0725	11.5					10.3	N	27.0	08/00	1018.6
PILM4	48.2N	088.4W	0737	11.2					9.7	W	26.7	12/05	1013.3
PTAC1	39.0N	123.7W	0725	11.4					10.1	N	24.9	13/11	1015.0
PTAT2	27.8N	097.1W	0717	27.5	28.6				12.6	SE	23.1	12/07	1014.7
ROAM4	47.9N	089.3W	0738	13.8	9.5				10.8	SW	30.2	12/07	1013.7
SANF1	24.5N	081.9W	0677	28.2	29.4				11.5	E	22.9	22/17	1018.3
SAUF1	29.9N	081.3W	0739	24.6	24.3				6.4	S	18.5	29/20	1019.5
SBIO1	41.6N	082.8W	0724	23.2					9.1	SW	31.4	09/01	1015.4
SGNW3	43.8N	087.7W	0728	21.0					9.4	S	26.5	20/10	1014.9
SISW1	48.3N	122.9W	0726	12.9					10.0	SW	26.0	02/06	1018.0
SMKF1	24.6N	081.1W	0734	28.6	29.4				11.6	E	27.8	07/04	1018.8
SPGF1	26.7N	079.0W	0267	28.0	29.6				4.4	S	14.5	22/13	1018.4
SRST2	29.7N	094.1W	0730	28.2					11.3	S	23.0	27/06	1016.1
STDM4	47.2N	087.2W	0740	13.7					14.6	W	32.1	12/14	1012.8
SUPN6	44.5N	075.8W	0736	21.5	20.5				8.0	SW	26.2	23/19	1015.2
SVLS1	32.0N	080.7W	0735		28.8	0.7	1.5	27/21	12.4	S	32.4	28/17	1018.8
THIN6	44.3N	076.0W	0735	21.0									
TPLM2	38.9N	076.4W	0735	25.6	27.0				9.3	S	33.3	21/23	1016.3
TTIW1	48.4N	124.7W	0725	12.4					10.5	S	30.6	23/17	1019.5
VENF1	27.1N	082.5W	0723	26.4	30.1				6.9	E	22.4	28/21	1019.2
WPOW1	47.7N	122.4W	0720	16.1					3.6	NE	24.2	01/17	1018.0
AUGUST		**1994**											
32302	18.0S	085.1W	0740	17.4	18.0	2.6	4.7	07/18	13.8	SE	20.6	09/13	1017.5
41001	34.7N	072.7W	0222	26.9	28.3	1.1	2.3	07/02	10.4	SW	19.4	06/18	1018.1
41002	32.3N	075.2W	0740	27.1	28.1	1.2	2.5	23/01	8.6	S	25.1	14/06	1018.9
41004	32.5N	079.1W	0741	26.3	27.0	1.0	1.9	07/15	10.7	S	25.1	19/07	1019.0
41006	29.3N	077.3W	0742	27.5	28.7	1.0	2.3	12/20	9.0	SE	23.7	12/19	1018.4
41009	28.5N	080.2W	1474	27.1	28.1	0.7	1.8	12/16	8.0	SE	24.5	12/15	1017.8
41010	28.9N	078.5W	1483	27.6	28.7	1.0	2.3	12/18	8.1	SE	26.8	22/04	1018.4
41016	24.6N	076.5W	0741	28.1	29.2	0.5	2.0	11/17	10.4	E	31.4	11/11	1018.5
41018	15.0N	075.0W	0552	27.9	27.9	2.2	3.5	26/18	18.4	SE	24.5	27/22	1011.6
41021	31.9N	080.9W	0714	26.4	27.6	0.7	1.8	16/19	10.4	S	28.6	16/01	1017.4
42001	25.9N	089.7W	0739	28.3	29.2	0.5	1.4	02/03	8.1	E	25.6	01/00	1016.3
42002	25.9N	093.6W	0740	28.6	29.5	0.8	2.4	31/15	9.5	SE	28.6	01/14	1015.5
42003	25.9N	085.9W	0729		29.3	0.6	2.0	23/12	8.5	E	28.8	14/17	1017.3
42007	30.1N	088.8W	0739	27.4	29.0				9.6	E	30.7	21/22	1016.5
42019	27.9N	095.0W	0742	28.3	29.0	0.9	1.7	02/09	9.2	SE	24.3	03/17	1015.2
42020	27.0N	096.5W	0740	28.3	28.6	0.9	2.1	31/12	10.5	SE	25.5	04/17	1014.9
42035	29.3N	094.4W	0742	28.1	29.3	0.6	1.6	02/13	8.6	SE	21.4	09/11	1015.9
42036	28.5N	084.5W	0740	27.9	28.1	0.8	4.1	15/20	9.1	E	32.4	15/19	1017.4
42037	24.5N	081.4W	0742	28.2	29.2	0.5	1.4	27/07	7.4	E	17.3	25/14	1016.9
44004	38.5N	070.7W	0741	24.4	26.0	1.3	3.6	23/16	11.2	SW	25.6	15/08	1018.0
44005	42.9N	069.0W	0740	19.5	19.5	1.1	3.4	15/03	10.4	SW	26.2	14/20	1016.0
44007	43.5N	070.2W	0741	17.3	16.2	0.6	1.4	29/04	8.1	S	21.6	05/23	1014.8
44008	40.5N	069.4W	0735		19.6	1.2	3.2	23/05	8.9	S	23.3	23/05	1017.3
44009	38.5N	074.7W	0742	20.7	19.8	0.9	2.7	23/05	8.4	S	23.5	22/19	1018.0
44011	41.1N	066.6W	0741	19.9	20.1	1.3	3.2	15/03	9.4	SW	22.3	13/17	1016.7
44013	42.4N	070.7W	0741	18.7	17.4	0.5	2.2	06/09					1016.1
44014	36.6N	074.8W	0741	24.1		1.0	2.9	23/14	10.6	SW	24.9	17/15	1019.0
44025	40.3N	073.2W	0740	20.8	20.2	0.9	3.3	23/01	9.4	SW	34.4	22/22	1016.8
44028	41.4N	071.1W	0741	20.1	19.9	0.7	2.4	14/17	11.2	SW	30.9	22/21	1017.0
45001	48.1N	087.8W	0732	11.7	10.2	0.5	2.5	28/11	9.2	SW	25.1	28/12	1014.6
45002	45.3N	086.4W	0742	17.4	17.4	0.7	2.4	28/05	11.1	S	26.8	28/03	1015.4
45003	45.3N	082.8W	0740	15.9	15.4	0.6	2.7	14/22	9.9	S	28.0	14/20	1015.5
45004	47.6N	086.5W	0738	8.7	6.3	0.5	3.0	28/13	8.6	W	26.8	28/08	1015.7
45005	41.7N	082.4W	0740	21.2	22.4	0.4	1.9	05/13	9.3	S	23.7	05/13	1016.7
45006	47.3N	089.9W	0742	15.0	13.7	0.6	2.2	28/07	7.1	SW	20.1	04/04	1015.1
45007	42.8N	087.1W	0740	19.1	19.5	0.7	3.6	04/23	9.5	S	24.3	30/22	1016.7
45008	44.3N	082.4W	0741	18.0	18.1	0.7	2.1	04/23	8.6	S	21.4	14/17	1016.1
45010	43.0N	087.8W	0741	18.4	17.7	0.5	2.8	05/03	7.4	S	20.8	28/02	1016.5
46001	56.3N	148.2W	0737		13.5	1.5	4.2	22/03	11.3	W	26.2	22/00	1019.3
46002	42.5N	130.3W	0733	17.4	18.2	1.5	2.5	31/07	10.4	NW	22.3	26/04	1020.1

July, August and September 1994

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
46003	51.9N	155.9W	0740	12.1	12.3	1.5	2.8	11/10	10.8	W	21.0	09/23	1022.3
46005	46.1N	131.0W	0734	16.3	17.0	1.4	2.8	24/05	10.2	NW	20.2	25/09	1019.5
46006	40.9N	137.5W	0740	17.7	18.7	1.5	3.3	26/05	10.7	N	22.9	25/22	1024.6
46011	34.9N	120.9W	0717	16.0	17.1	1.5	2.7	20/11	9.4	NW	23.9	29/22	1013.2
46012	37.4N	122.7W	0320	13.8	13.3	1.5	2.9	21/03	7.4	NW	17.1	31/14	1015.6
46013	38.2N	123.3W	0736	12.5	11.0	1.8	3.4	06/03	18.1	N	30.3	05/01	1013.9
46014	39.2N	124.0W	0740	13.1	11.5	1.7	3.7	18/02	12.8	NW	26.6	16/23	1015.9
46022	40.8N	124.5W	0737	14.4	13.8	1.3	2.9	24/23	6.3	N	21.0	31/12	1017.5
46023	34.3N	120.7W	0741	15.1	15.7	2.0	3.2	05/01	17.1	NW	26.0	05/04	1014.1
46025	33.8N	119.1W	0667	19.3	20.3	0.9	1.5	01/04	5.5	W	13.4	13/05	1012.6
46026	37.8N	122.8W	0740		12.5	1.4	2.8	21/02	10.3	NW	21.6	21/03	1014.9
46027	41.9N	124.4W	0740	13.1	11.7	1.2	2.5	25/03	7.3	N	25.5	17/01	1017.0
46028	35.8N	121.9W	0732	13.9		1.8	3.0	21/04	17.1	NW	28.4	21/05	1014.6
46029	46.2N	124.2W	0739	17.7	15.6	1.0	2.3	24/14	6.6	N	19.3	30/23	1018.4
46030	40.4N	124.5W	0169	12.2	10.5	1.4	2.6	25/05	8.5	N	16.1	31/14	1016.6
46035	57.0N	177.7W	0737	8.4	8.5	1.9	4.1	13/21	15.1	SW	30.3	06/08	1010.1
46041	47.4N	124.5W	0738	16.0	16.9	0.9	2.4	24/07	6.8	N	18.7	31/22	1017.9
46042	36.8N	122.4W	0731	13.6	13.2	1.6	2.9	21/06	12.3	NW	23.3	15/23	1015.8
46045	33.8N	118.5W	0739	20.3	21.7	0.8	1.5	02/05	5.6	SW	14.2	26/21	1012.6
46050	44.6N	124.5W	0740	16.8		1.1	2.7	24/13	7.1	N	18.7	30/23	1017.4
46051	34.5N	120.7W	0229	13.1	12.7				16.5	NW	23.7	05/03	1014.1
46053	34.2N	119.9W	0742	17.5	18.6	1.0	1.9	03/00	10.1	W	25.8	03/02	1012.4
46054	34.3N	120.5W	0739	15.2	16.5	1.8	3.0	05/02	20.4	NW	33.4	29/05	1013.4
51001	23.4N	162.3W	0741	27.7	27.1				13.8	SE	22.7	26/07	1016.5
51002	17.2N	157.8W	0337	26.9	27.2	2.3	3.5	12/20	16.6	E	24.5	12/19	1013.5
51003	19.1N	160.8W	0740	26.7	27.5	2.1	4.7	23/22	12.1	E	21.7	24/15	1013.5
51004	17.4N	152.5W	0741	26.5	27.1	2.5	5.0	22/22	16.3	NE	34.2	11/19	1014.4
51026	21.4N	157.0W	0740	26.9	28.8				4.8	NE	11.1	18/23	1014.8
91222	18.1N	145.8E	0664	28.2					4.9	E	18.5	02/02	1008.7
91251	11.4N	162.4E	0242	28.3					5.3	E	21.4	31/08	1008.7
91328	8.6N	149.7E	0235	27.8					3.2	SW	11.7	28/20	1007.4
91338	5.3N	153.7E	0231	27.3					2.8	SW	15.5	28/18	1008.8
91343	7.6N	155.2E	0226	27.7					1.6	N	9.7	31/17	1010.4
91352	6.2N	160.7E	0225	28.1					2.8	N	13.6	27/09	1009.5
91355	5.4N	163.0E	0214	26.8					2.9	E	11.7	28/05	1010.0
91377	6.1N	172.1E	0355	28.4					4.9	E	18.9	03/08	1010.7
ABAN6	44.3N	075.9W	0740	19.0	20.9				3.1	S	15.2	22/13	1017.5
ALSN6	40.5N	073.8W	0742	21.1	21.9	0.7	2.1	23/03	12.7	SW	38.0	22/23	1017.3
BURL1	28.9N	089.4W	0734	27.6					9.2	NE	24.0	21/20	1016.7
CARO3	43.3N	124.4W	0735	15.6					4.5	N	17.1	30/20	1018.5
CHLV2	36.9N	075.7W	0742	22.7	22.7				11.7	S	33.2	04/21	1018.6
CLKN7	34.6N	076.5W	0742	25.6					10.3	SW	21.0	15/19	1019.5
CSBF1	29.7N	085.4W	0734	26.7					7.0	NE	29.8	16/09	1017.2
DBLN6	42.5N	079.4W	0742	20.1					8.4	SW	30.2	04/20	1017.7
DESW1	47.7N	124.5W	0734	15.7					7.8	NW	24.7	31/01	1018.0
DISW3	47.1N	090.7W	0741	16.6					10.2	W	34.9	26/01	1015.8
DPIA1	30.3N	088.1W	0627	27.0					7.8	SE	25.1	02/15	1017.0
DRYF1	24.6N	082.9W	0741	28.5					8.1	E	22.9	25/01	1016.9
DSLN7	35.2N	075.3W	0742	25.5	26.4				13.9	SW	30.5	19/08	1019.5
FBIS1	32.7N	079.9W	0742	26.4					9.2	SW	30.9	17/04	1018.7
FFIA2	57.3N	133.6W	0733	13.7					6.2	N	22.0	22/00	1017.2
FPSN7	33.5N	077.6W	0741	25.9		1.0	2.2	06/19					1018.8
FWYF1	25.6N	080.1W	0739	28.2	29.5				10.1	SE	33.0	14/07	1017.8
GDIL1	29.3N	090.0W	0733	27.6	29.7				7.6	E	29.5	02/13	1017.1
GLLN6	43.9N	076.5W	0741	19.9					11.1	W	35.8	14/20	1015.3
IOSN3	43.0N	070.6W	0740	18.8					12.1	SW	25.7	05/00	1015.6
LKWF1	26.6N	080.0W	0741	27.6	29.2				9.0	SE	27.5	12/02	1018.4
LONF1	24.9N	080.9W	0742	28.3	30.0				8.5	SE	30.0	11/18	1017.1
MDRM1	44.0N	068.1W	0742	16.4					12.3	S	26.9	15/02	1015.3
MISM1	43.8N	068.9W	0741	16.4					12.2	SW	26.1	29/04	1015.3
MLRF1	25.0N	080.4W	0742	28.3	29.5				8.9	SE	32.2	27/02	1016.9
NWPO3	44.6N	124.1W	0733	15.0					5.7	NW	21.2	30/01	1017.7
PILM4	48.2N	088.4W	0739	13.8					11.5	W	35.0	28/10	1015.0
PTAC1	39.0N	123.7W	0734	12.7					12.2	N	24.9	20/08	1015.6
PTAT2	27.8N	097.1W	0734	28.1	29.4				12.5	SE	24.9	24/01	1014.8
PTGC1	34.6N	120.7W	0604	14.3					19.5	N	33.0	29/06	1012.7
ROAM4	47.9N	089.3W	0741	14.6	12.6				12.5	SW	32.5	28/08	1015.1
SANF1	24.5N	081.9W	0741	28.2	29.5				9.0	E	23.2	12/23	1017.0
SAUF1	29.9N	081.3W	0742	25.5	26.1				8.0	SE	24.2	15/23	1018.5
SBIO1	41.6N	082.8W	0741	21.3					9.0	SW	27.3	20/19	1017.1
SGNW3	43.8N	087.7W	0742	20.8	14.8				9.2	S	26.1	28/06	1017.3
SISW1	48.3N	122.9W	0734	13.7					9.2	SW	21.4	03/06	1017.3
SMKF1	24.6N	081.1W	0739	28.6	29.7				9.5	E	23.8	24/23	1017.4
SPGF1	26.7N	079.0W	0741	27.7	29.7				5.1	SE	27.1	28/20	1018.0
SRST2	29.7N	094.1W	0734	27.3					8.6	S	25.3	09/09	1016.2
STDM4	47.2N	087.2W	0742	14.4					14.7	S	40.5	28/13	1015.0
SUPN6	44.5N	075.8W	0742	19.2	21.5				9.0	SW	31.8	28/18	1016.3
SVLS1	32.0N	080.7W	0731		28.6	0.8	2.0	16/22	12.3	S	28.7	22/01	1018.5
THIN6	44.3N	076.0W	0740	18.7									
TPLM2	38.9N	076.4W	0742	23.5	25.5				10.1	S	25.9	06/05	1017.1
TTIW1	48.4N	124.7W	0733	14.7					7.6	S	28.1	27/16	1018.4
VENF1	27.1N	082.5W	0707	26.5	30.0				6.8	E	26.7	16/22	1017.9
WPOW1	47.7N	122.4W	0732	16.5					3.6	NE	15.2	28/14	1017.3
SEPTEMBER 1994													
32302	18.0S	085.1W	0715	17.5	18.2	2.1	3.8	01/11	11.3	SE	21.6	01/03	1016.0
41002	32.3N	075.2W	0718	25.6	27.3	1.2	3.4	05/15	9.3	SW	24.1	19/23	1017.0
41004	32.5N	079.1W	0713	24.8	26.0	1.0	3.1	22/00	10.4	SW	29.0	21/21	1017.7

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BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
41006	29.3N	077.3W	0715	26.9	28.3	1.1	3.0	06/02	9.5	E	23.5	19/08	1016.7
41009	28.5N	080.2W	1425	26.8	27.8	0.7	2.7	13/12	9.5	SE	24.9	12/22	1016.3
41010	28.9N	078.5W	1186	27.1	28.5	1.2	2.7	13/05	9.1	E	21.2	13/04	1017.2
41016	24.6N	076.5W	0714	28.3	29.3	0.5	1.4	13/05	10.4	SE	22.7	12/21	1016.9
41018	15.0N	075.0W	0712	28.0	28.2	1.9	3.7	12/18	16.0	E	23.7	12/18	1011.7
41021	31.9N	080.9W	0151	25.0	26.9	0.5	1.1	05/11	10.1	S	18.8	02/22	1018.3
42001	25.9N	089.7W	0711	27.8	29.1	0.7	3.4	30/23	9.2	NE	29.7	30/23	1014.6
42002	25.9N	093.6W	0711	27.8	29.3	0.8	3.2	30/19	9.0	NE	28.2	30/21	1014.8
42007	30.1N	088.8W	0715	26.0	28.1				11.0	E	29.3	15/07	1015.7
42019	27.9N	095.0W	0717	27.4	28.9				8.9	E	21.2	23/11	1014.9
42020	27.0N	096.5W	0715	27.6	28.7	0.8	2.4	23/06	8.9	SE	21.6	23/03	1015.1
42035	29.3N	094.4W	0710	26.9	28.7	0.6	1.5	01/04	9.3	E	24.1	23/05	1015.6
42036	28.5N	084.5W	0710	27.6	28.0	0.8	2.4	14/03	10.2	E	24.1	14/03	1016.3
42037	24.5N	081.4W	0714	27.9	28.9	0.5	2.0	30/16	7.9	E	25.6	14/18	1015.2
44004	38.5N	070.7W	0658	21.3	23.3	1.7	5.5	04/23	13.5	W	32.8	04/21	1021.1
44005	42.9N	069.0W	0716	14.9	14.8	1.2	6.4	05/19	10.9	SW	38.3	05/19	1014.6
44007	43.5N	070.2W	0714	14.4	14.2	0.7	3.9	05/20	9.3	W	33.2	05/18	1013.9
44008	40.5N	069.4W	0715		15.9	1.3	5.1	05/14	10.4	NW	29.3	05/12	1015.4
44009	38.5N	074.7W	0710	19.4	19.2	1.0	4.9	22/21	10.8	S	36.7	22/18	1016.9
44011	41.1N	066.6W	0713	16.6	16.9	1.5	6.3	05/04	11.0	SW	33.4	05/16	1014.2
44013	42.4N	070.7W	0710	16.0	15.8	0.7	4.4	05/15	10.9	NE	26.8	23/18	1014.9
44014	36.6N	074.8W	0713	21.5		1.2	4.6	22/10	10.9	SW	32.3	22/09	1017.1
44025	40.3N	073.2W	0712	18.9	19.1	1.0	5.1	23/04	12.4	W	33.2	23/02	1015.8
44028	41.4N	071.1W	0709	17.3	17.7	0.6	2.6	23/12	13.0	SW	32.1	18/11	1015.6
45001	48.1N	087.8W	0588	13.2	12.5	0.5	3.2	25/15	9.3	SE	32.8	25/14	1016.4
45002	45.3N	086.4W	0608	17.6	17.5	0.6	2.1	26/10	10.1	S	26.2	26/04	1017.5
45003	45.3N	082.8W	0716	15.1	15.1	0.5	3.0	28/22	9.5	NW	29.5	29/00	1016.3
45004	47.6N	086.5W	0716	10.9	9.8	0.5	2.8	25/20	8.9	SE	26.6	25/23	1016.2
45005	41.7N	082.4W	0718	19.0	21.0	0.5	1.5	25/01	10.7	SW	29.0	28/17	1017.2
45006	47.3N	089.9W	0717	14.5	14.1	0.7	3.9	26/06	8.4	NE	27.3	25/16	1015.2
45007	42.8N	087.1W	0709	18.5	19.3	0.6	2.2	28/12	10.0	S	26.6	28/10	1016.6
45008	44.3N	082.4W	0718	16.7	17.2	0.7	3.0	29/03	9.5	SE	23.1	29/11	1016.5
45010	43.0N	087.8W	0712	16.3	15.0	0.5	1.7	26/11	6.9	SE	17.1	22/19	1016.4
46001	56.3N	148.2W	0708		12.3	2.6	8.1	24/19	14.9	SW	39.4	21/23	1004.7
46002	42.5N	130.3W	0715	17.4	18.2	2.1	4.3	26/12	12.4	N	23.9	21/17	1019.0
46003	51.9N	155.9W	0714	10.4	10.6	3.1	11.8	20/08	18.1	W	40.0	20/07	1007.2
46005	46.1N	131.0W	0710	16.2	17.1	2.0	4.7	26/00	11.0	W	22.0	03/03	1018.9
46006	40.9N	137.5W	0710	17.8	18.5	2.0	4.3	08/23	9.9	NW	22.2	08/22	1022.1
46011	34.9N	120.9W	0712	14.7	14.9	1.4	2.7	26/19	9.6	NW	22.3	03/23	1014.6
46012	37.4N	122.7W	0712	14.4	14.3	1.4	2.5	01/01	6.5	NW	18.1	04/01	1015.5
46013	38.2N	123.3W	0706	13.0	12.6	1.6	3.0	02/08	6.0	NW	22.2	30/02	1015.5
46014	39.2N	124.0W	0709	13.4	13.5	1.8	3.6	26/18	8.3	NW	25.5	02/03	1015.8
46022	40.8N	124.5W	0713	13.3	13.0	1.7	4.1	21/00	6.9	N	19.6	19/08	1016.1
46023	34.3N	120.7W	0718	15.7	16.2	1.6	3.0	10/16	14.0	NW	23.6	02/23	1015.0
46025	33.8N	119.1W	0637	18.4	19.7	0.8	1.6	11/01	6.6	W	19.8	13/01	1013.9
46026	37.8N	122.8W	0710		13.7	1.2	2.5	01/00	6.8	NW	22.3	01/03	1015.4
46027	41.9N	124.4W	0711	12.6	12.0	1.7	3.8	21/01	7.7	NW	28.0	13/01	1015.8
46028	35.8N	121.9W	0708	15.1		1.6	2.8	04/05	11.8	NW	29.3	03/03	1015.5
46029	46.2N	124.2W	0712	15.7	13.5	1.7	3.4	17/09	9.9	NE	26.8	03/02	1017.5
46030	40.4N	124.5W	0712	12.5	11.5	1.7	3.9	20/21	9.3	N	21.0	19/19	1015.8
46035	57.0N	177.7W	0690	7.0	8.4	2.5	6.0	16/21	18.6	N	34.6	27/17	1009.5
46041	47.4N	124.5W	0075	13.4	13.3	1.6	3.8	03/04	9.3	SE	24.9	03/03	1013.7
46042	36.8N	122.4W	0712	14.4	14.7	1.6	2.7	19/21	7.9	NW	20.6	03/23	1015.6
46045	33.8N	118.5W	0711	19.1	20.5	0.7	1.7	13/05	5.7	W	19.0	13/02	1013.5
46050	44.6N	124.5W	0444	15.7		1.8	3.1	04/12	8.9	N	20.0	03/01	1016.7
46053	34.2N	119.9W	0716	16.9	18.0	0.9	2.0	10/23	10.4	W	27.4	12/23	1014.0
46054	34.3N	120.5W	0716	15.4	15.8	1.5	2.6	02/22	17.0	NW	31.9	02/22	1014.5
51001	23.4N	162.3W	0715	27.7	27.3				12.5	E	22.0	08/06	1014.8
51002	17.2N	157.8W	0496	26.8	27.4	2.0	2.7	11/04	14.6	E	21.1	15/16	1012.6
51003	19.1N	160.8W	0712	27.3	27.9	1.8	2.6	20/19	10.3	E	20.1	30/07	1012.3
51004	17.4N	152.5W	0709	26.6	27.4	2.2	4.6	02/07	15.2	NE	24.5	02/14	1013.6
51026	21.4N	157.0W	0353	25.6	26.3	1.6	2.4	19/08	15.4	E	22.0	19/07	1014.1
91222	18.1N	145.8E	0580	28.0					4.7	E	19.6	25/23	1007.3
91251	11.1N	162.1E	0212	28.0					10.9	S	38.9	26/19	1007.9
91328	8.6N	149.7E	0213	27.7					9.4	S	33.0	13/10	1008.5
91338	5.3N	153.7E	0207	27.7					8.5	SW	23.3	12/20	1009.2
91343	7.6N	155.2E	0209	27.8					4.8	SW	13.6	18/19	1010.4
91352	6.2N	160.7E	0238	28.0					6.5	N	27.2	10/19	1010.1
91355	5.1N	163.0E	0205	27.2					8.6	SW	29.1	10/19	1010.4
91377	6.1N	172.1E	0394	28.2					6.5	SW	21.6	27/16	1011.5
ANAN6	44.3N	075.9W	0713	15.9	18.6				3.5	S	17.8	27/17	1018.1
ALSN6	40.5N	073.8W	0715	18.9	19.3	0.7	3.5	23/07	13.8	W	42.5	23/02	1016.5
BURL1	28.9N	089.4W	0703	26.7					9.6	E	24.6	30/21	1015.5
CARO3	43.3N	124.4W	0706	13.3					8.3	NE	26.4	09/21	1016.8
CHLV2	36.9N	075.7W	0718	21.2	22.2				13.1	NE	41.5	22/13	1017.4
CLKN7	34.6N	076.5W	0695	23.6					10.9	SW	31.4	22/02	1018.2
CSBF1	29.7N	085.4W	0709	25.6					7.0	NE	26.3	18/06	1016.5
DBLN6	42.5N	079.4W	0708	17.3					9.9	SW	33.3	29/21	1018.0
DESW1	47.7N	124.5W	0712	13.6					10.4	NW	32.4	08/00	1017.3
DISW3	47.1N	090.7W	0714	14.7					10.0	SW	36.2	25/15	1016.0
DPIA1	30.3N	088.1W	0694	25.5	32.8				9.5	E	25.2	15/12	1016.5
DRYF1	24.6N	082.9W	0710	28.1					8.4	E	28.8	30/13	1015.2
DSLN7	35.2N	075.3W	0714	23.7	26.1	1.2	2.0	22/00	14.9	W	44.0	22/05	1017.8
FBIS1	32.7N	079.9W	0717	24.4					9.0	SW	25.0	18/20	1017.6
FFIA2	57.3N	133.6W	0710	11.0					10.5	SE	32.1	15/00	1011.9
FPSN7	33.5N	077.6W	0716	24.4		1.0	3.3	22/02	12.6	NE	42.6	21/22	1017.3
FWYF1	25.6N	080.1W	0703	27.9	29.0				10.0	E	28.5	14/20	1016.1
GDIL1	29.3N	090.0W	0709	26.4	28.4				8.8	E	21.8	16/03	1016.2

July, August and September 1994

BUOY	LAT	LONG	OBS	MEAN AIR TP (C)	MEAN SEA TP (C)	MEAN SIG WAVE HT (M)	MAX SIG WAVE HT (M)	MAX SIG WAVE HT (DA/HR)	SCALAR MEAN WIND SPEED (KNOTS)	PREV WIND (DIR)	MAX WIND (KTS)	MAX WIND (DA/HR)	MEAN PRESS (MB)
GLLN6	43.9N	076.5W	0717	16.8					12.3	W	33.2	29/22	1015.5
IOSN3	43.0N	070.6W	0711	15.4					12.3	W	39.8	05/18	1014.6
LKWF1	26.6N	080.0W	0715	27.2	28.8				8.4	E	28.2	13/15	1016.8
LONF1	24.9N	080.9W	0712	27.9	29.3				8.6	E	31.5	14/04	1015.4
MDRM1	44.0N	068.1W	0713	13.4					13.3	SW	48.9	05/19	1014.0
MISM1	43.8N	068.9W	0716	13.5					13.9	W	39.9	05/17	1014.1
MLRF1	25.0N	080.4W	0711	28.1	29.2				9.0	SE	26.6	15/03	1015.3
NWPO3	44.6N	124.1W	0709	13.4					8.1	S	25.7	20/21	1016.6
PILM4	48.2N	088.4W	0715	13.0					11.1	W	25.0	07/11	1015.8
PTAC1	39.0N	123.7W	0709	12.9					7.9	N	19.7	01/04	1015.7
PTAT2	27.8N	097.1W	0710	26.8	28.5				10.0	E	23.5	23/01	1015.2
PTGC1	34.6N	120.7W	0704	14.3					15.9	N	27.0	07/04	1013.6
ROAM4	47.9N	089.3W	0715	13.7	13.1				11.9	SW	39.6	25/15	1015.6
SANF1	24.5N	081.9W	0714	27.9	29.1				9.6	E	29.9	30/17	1015.3
SAUF1	29.9N	081.3W	0714	25.2	27.1				9.5	E	28.4	21/21	1017.2
SBIO1	41.6N	082.8W	0715	19.0					10.1	SW	32.5	29/00	1017.5
SGNW3	43.8N	087.7W	0714	20.0	17.6				9.0	S	27.7	26/03	1017.2
SISW1	48.3N	122.9W	0710	12.6					6.1	W	27.7	01/06	1017.1
SMKF1	24.6N	081.1W	0714	28.2	29.4				10.1	E	29.3	14/04	1015.7
SPGF1	26.7N	079.0W	0712	27.3	29.2				5.1	SE	17.9	12/21	1016.4
SRST2	29.7N	094.1W	0711	25.3					7.6	N	20.4	11/08	1015.9
STDM4	47.2N	087.2W	0716	13.9					13.7	SE	34.3	25/16	1015.6
SUPN6	44.5N	075.8W	0716	15.9	18.9				9.0	SW	22.0	27/17	1016.7
SVLS1	32.0N	080.7W	0707	25.3	27.4	0.7	2.1	21/15	12.7	NE	32.0	09/02	1017.4
THIN6	44.3N	076.0W	0708	15.6									
TPLM2	38.9N	076.4W	0715	20.5	22.6				10.2	W	48.5	22/23	1016.7
TTIW1	48.4N	124.7W	0316	12.7					8.4	S	24.9	08/01	1016.5
VENF1	27.1N	082.5W	0709	25.8	29.2				6.8	E	19.6	15/21	1016.4
WPOW1	47.7N	122.4W	0710	15.2					5.1	NE	24.0	03/10	1017.0

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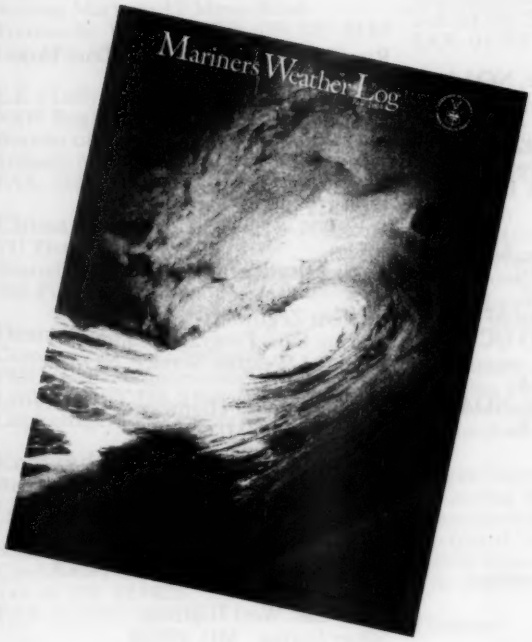

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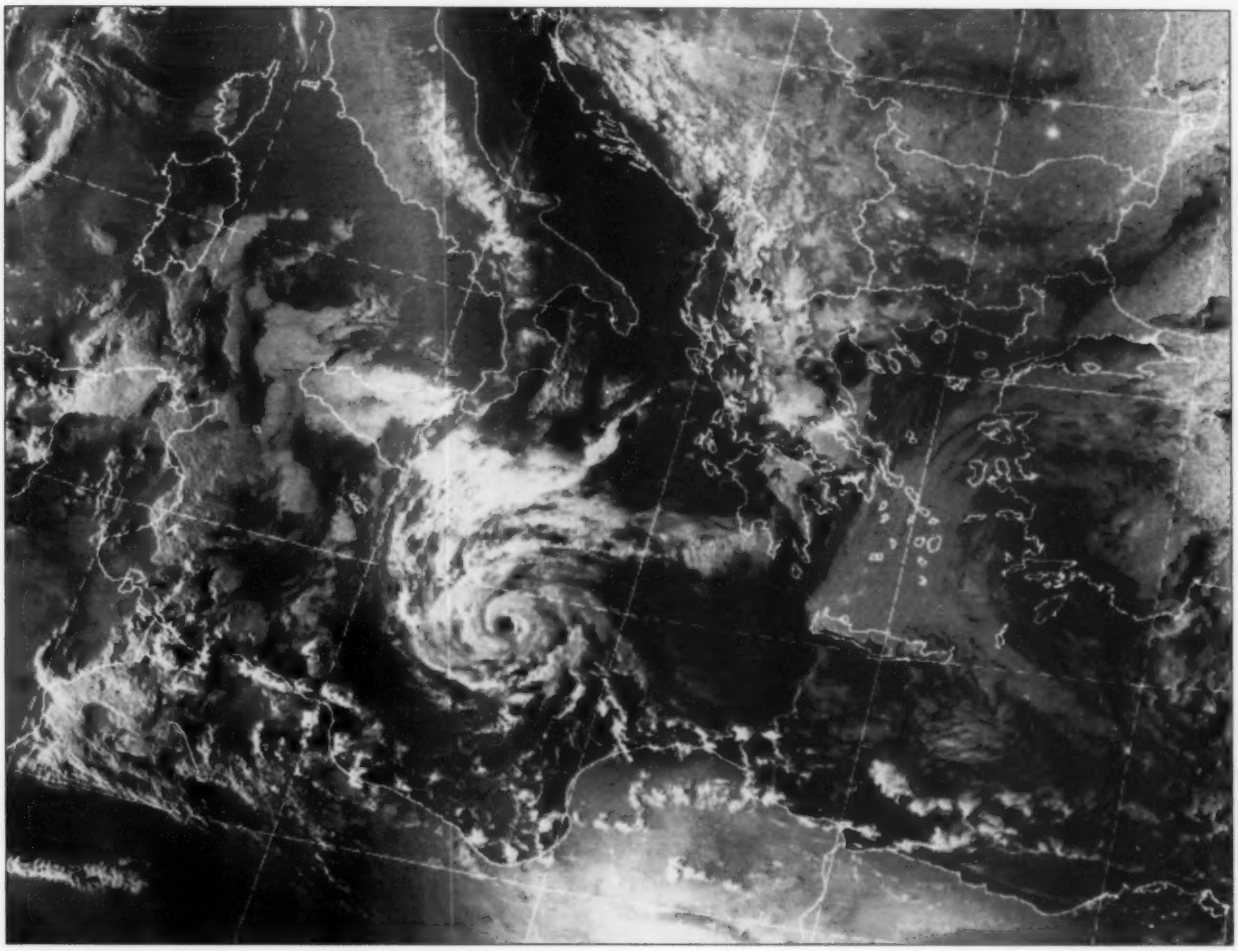

Back in January 26, 1982, the Center of Satellite Meteorology in Lannion located a tropical cyclone in the Mediterranean Sea between Greece and Sicily. Thanks to ship reports they were able to confirm its existence. A recent phone call and photograph from Charles R. Holiday (Chief, Satellite Applications) from the Air Force Global Weather Central indicates the possibility that another tropical cyclone or at least subtropical cyclone may have occurred around January 15–17, 1995. The satellite photograph above is a DMSP F11 VIS/IR image for 1616 UTC on January 16, 1995. So far they have only been able to come up with a few ship reports from the PGDF, 9VT and the GOYE. While they were a distance away from the center their reports are extremely helpful. If anyone else was in the vicinity of 34°N, 18°E on the 16th or near the Gulf of Sidra the following day please get in touch with the Mariners Weather Log and we will forward the information to the Global Weather Center. As usual ship reports play a critical role in both forecasting and research of marine weather phenomena. More on this story as it develops, as Dan Rather would say.

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